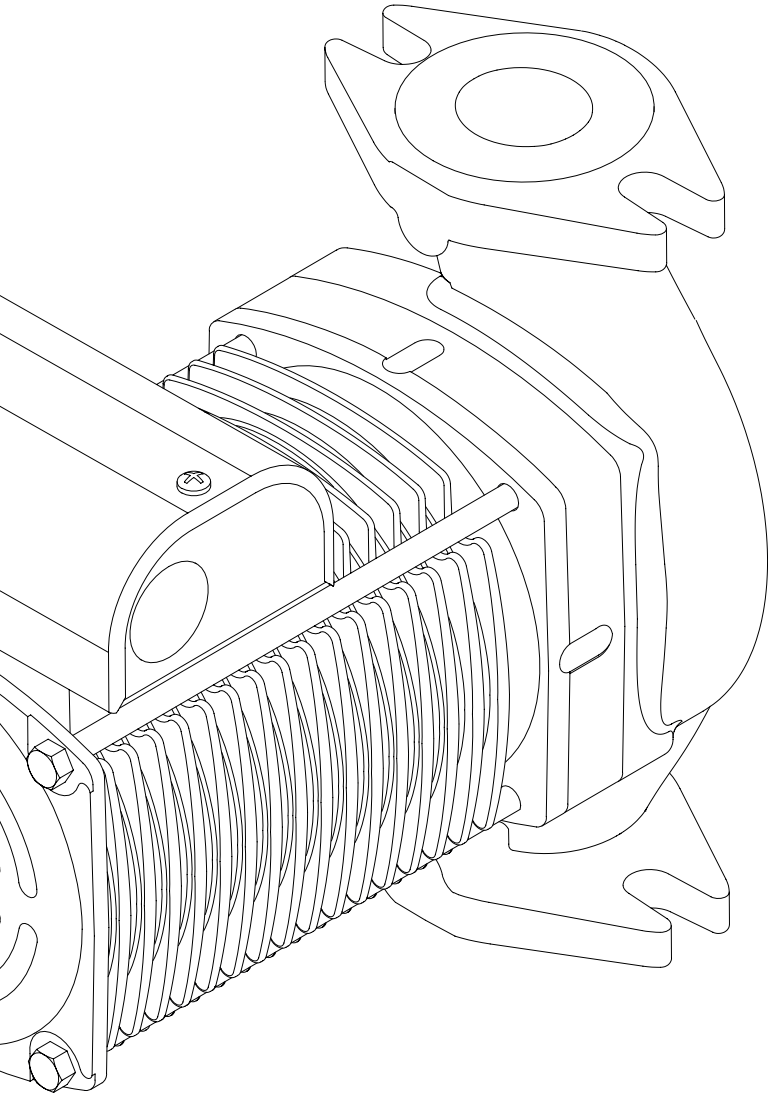
ARMSTRONG

Kelly Walsh High School
Tag: PHX-1 Model # E12.2 CI 120V
Part # 182212-841
Tag: PHX-2 Model # E17.2 CI 120V
Part # 182212-663
Tag: PHX-3 Model # E10.2 CI 120V
Tag: PHX-4 Model # E10.2 CI 120V
Part # 182202-649
Tag: RCP1-3 Model # E12.2B BRZ 120V
Part # 182212-842



E.2 series high efficiency circulator

Installation and operating instructions

File No: 10.84
Date: AUGUST 16, 2012
Supersedes: 10.84
Date: JULY 20, 2010

CONTENTS

READ CAREFULLY BEFORE INSTALLING & OPERATING THE CIRCULATOR

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE

You are about to install an E.2 Series circulator – a high-efficiency pump from Armstrong. E.2 Series circulators are designed for heating and cooling in hydronic, geothermal or solar systems and circulating water, ethylene or propylene glycol/water solutions. For pumping domestic (potable) water, Armstrong recommends the use of circulators with bronze body construction.

The E.2 Series circulators are extremely efficient and quiet. They utilize a state of the art permanently lubricated bearing system designed for many years of trouble-free operation. They feature a permanent-split capacitor motor with thermal protection.

1.0 OPERATING LIMITS

Maximum operating pressure:
150 psi (1034 kPa)

Maximum operating temperature:
All standard models 230°F (110°C)

Minimum operating temperature:
All standard models 32°F (0°C)

Electrical rating:
For models with ⅙ hp motors: 120 V, 1 phase, 60 Hz or 208/240 V, 1 phase, 60 Hz

For models with ⅔ hp motors: 120 V, 1 phase, 60 Hz or 208/240/277 V, 1 phase, 60 Hz

When unpacking the circulator, inspect for any damage that may have occurred during transit. Check for loose, missing or damaged parts.

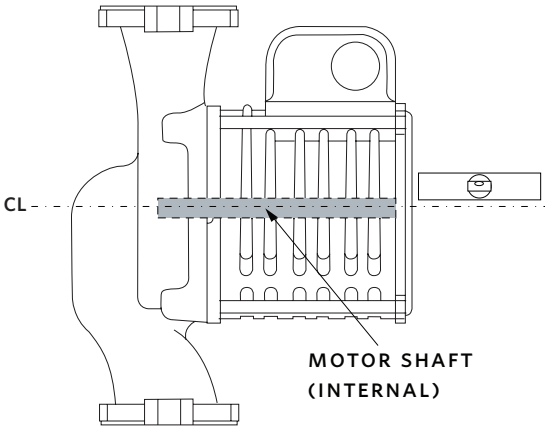
THIS PUMP IS FOR INDOOR USE ONLY

Before installing the circulator, proper installation practice recommends a thorough flush of the hydronic system, ensuring removal of all foreign materials.

WARNING

Mount with motor shaft horizontal and terminal box above centerline (CL) only!

The circulator is supplied for up-discharge.



For alternate discharge orientation:

1. Loosen the four motor mounting bolts
2. Rotate the volute to match piping orientation
3. Observe flow direction arrow on volute
4. Ensure volute gasket is properly seated
5. Retighten mounting bolts evenly to 5 lb/ft (6.7 N/m)
6. Ensure the impeller spins freely

2.0 ELECTRICAL WIRING

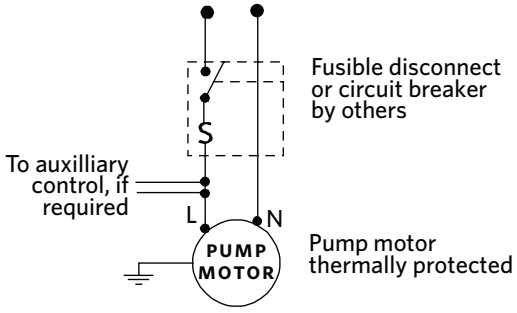
The electrical wiring must be installed in strict accordance with the Canadian Electrical Code or the U.S. National Electrical Code, as well as local codes and regulations.

1. Electrical installation should be conducted by a qualified electrician.
2. The motors of E.2 Series circulators are designed for 60 Hz, 1 phase, 120 V or 240 V service only. (Please refer to the rating label on the circulator's terminal box to determine the correct voltage.)
3. Always make sure the electric power is disconnected and locked out before wiring the circulator.
4. To wire, loosen the screw from the terminal box cover and remove the screw and cover.
5. Install the appropriate size conduit end to one of the holes on either side of the terminal box.
6. For 120 V models: Referring to **DIAGRAM 1** below, connect the black, hot, (L) and white, neutral, (N) leads of the supply wire to the black and white motor leads respectively inside the terminal box. Connect the ground wire to any one of the

four green ground screws inside of the terminal box (use a minimum 18 AWG wire size).

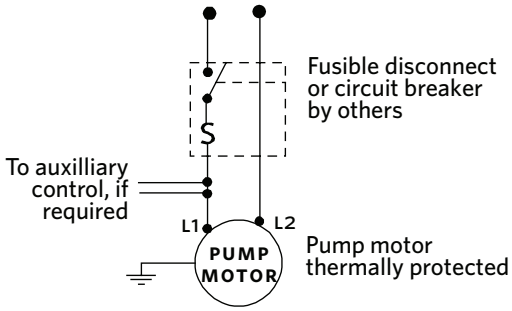
For 208/240/277 V models: Referring to **DIAGRAM 2** below, connect the black (L1) and blue (L2) leads of the supply wire to the black and white motor leads respectively inside the terminal box. Connect the ground wire to any one of the four green ground screws inside of the terminal box (use a minimum 18 AWG wire size).

DIAGRAM 1 120 V installations



Typical wiring diagram for
single phase, 120 V, 60 Hz power source

DIAGRAM 2 208/240/277 V installations



Typical wiring diagram for
A single phase, 240 V, 60 Hz power source
B three phase, 208/277 V, 60 Hz power source

7 Replace the terminal box cover.

The motor is thermally protected for your safety so overload protection is not necessary. All that is required is a fused plug or circuit breaker in the power line.

Electrical information can be found on the nameplate of the motor.

3.0 START UP

1 Before starting up the circulator, proper installation practice recommends a thorough flush and draining of the hydronic system, ensuring removal of all foreign materials. Fill the system with clean water or glycol solution before starting.

2 Air must be completely vented from the system before starting up the circulator. **If the system is not completely vented of air and the circulator is allowed to run dry, the mechanical seal will be damaged.**

3 When the system has been completely filled and vented, only then can the pump be started.

4.0 PREVENTIVE MAINTENANCE – INSPECTION

E.2 Series circulators are fitted with permanently lubricated ball bearings and **do not** require lubrication.

Although Armstrong long-life circulators are designed to provide years of worry-free service, it is good maintenance practice to inspect the entire hydronic system periodically – including the E.2 Series circulator – for potential problems. If there is any evidence of leakage or damage, repair or replace the pump.

Disconnect and lockout the power before servicing.

5.0 PUMP REPLACEMENT IN AN EXISTING INSTALLATION

5.1 COMPLETE PUMP

1 Ensure that electric power is disconnected and locked out. Loosen the screw from the terminal box cover and remove the cover. Disconnect the supply wires from the circulator only, leaving the capacitor wires connected.

2 If valves have been installed, on the suction and discharge sides of the pump, close them before attempting to remove the circulator from the volute. If no valves have been installed it may be necessary to drain the system.

Allow water to cool to 100°F (40°C) before draining the system. It is best to leave the drain valve open while working on the system.

3 To relieve any residual pressure which may be present in the pump body, loosen the flange bolts and gently move the pump body back and forth to allow the pressurized water to escape.

NOTE: Place a pan under the pump to collect the drain water.

4 If the entire volute is needed to be removed, then remove the flange bolts and nuts. The entire circulator can then be removed from the piping system.

5 Install the E.2 Series circulator where there will be sufficient room for inspection and service. It is recommended that isolation valves be installed on both the suction and discharge sides of the circulator for future servicing. This eliminates the need for draining the system when working on the circulator (for example, when replacing the mechanical seal).

6 Install suction and discharge flanges on the pipe ends. The use of Teflon tape sealer or a high quality thread sealant is recommended.

7 Pipe strain can be minimized by the use of pipe hangers near the pump, positioned to support the suction and discharge piping.

To wire the E.2 Series circulator, follow steps C through G in the Electrical Wiring section above, noting that electrical supply and grounding wires must be rated for at least 194°F (90°C).

5.2 MOTOR END ONLY

1 Turn off the pump leaving it installed in the line .

2 Ensure electrical power is disconnected and locked out .

3 Close the water supply at the points closest to the pump's inlet and outlet .

4 For safety, allow water to cool to 100°F (40°C) before draining the system. It is best to leave the drain valve open while working on the system.

5 Bleed the water pressure from the pump.

6 Place a pan under the pump to collect the drain water.

7 While holding the motor body, loosen the four bolts that attach the motor to the pump casing (volute). Start with the two bottom bolts first and remove them, then slowly loosen the top two bolts. Allow the water to drain from the bottom of the pump. When the water has finished draining, remove the two top bolts. Remove the motor straight out from the volute being careful of its attached impeller. The motor is heavy, do not drop it.

8 Install new casing gasket .

9 Install new motor end (with impeller and seal kit).

10 Tighten four motor end bolts in a crisscross pattern and tighten evenly to 70 in/lbs.

11 Open isolation flanges or fill the system with water before starting circulator.

12 To wire the E.2 Series circulator, follow steps C through G in the Electrical Wiring section above, noting that electrical supply and grounding wires must be rated for at least 194°F (90°C).

6.0 MECHANICAL SEAL REPLACEMENT

1 Follow steps 1 through 4 in section **Existing pump removal from system piping.**

2 While holding the motor body, remove the bottom two bolts that attach the motor to the pump casing (volute), then slowly loosen the top two bolts. Allow the water to drain from the bottom of the pump. When the water has finished draining, remove the two top bolts. Remove the motor straight out from the volute being careful of the attached impeller.

Handle with care
The motor is heavy, and possibly hot,
DO NOT drop it!

3 While holding the rotor very tightly by hand or a gloved hand only, unscrew the impeller nut off the motor shaft by turning it clockwise (i.e. opposite to most bolts and nuts). Place the motor on its back, with the shaft up.

4 Remove the rotary part of the mechanical seal by gently pulling it off the shaft. If it is too tight use two small flat bladed screwdrivers to gently pry it off the shaft by placing the flat side of the blades onto opposite sides of the mechanical seal.

5 Remove the face plate from the motor by gently prying it off of the motor housing extension, and carefully pulling it straight up, avoiding any shaft contact.

6 Remove the stationary part of the seal by gently prying it off the steel faceplate.

7 Remove any corrosion present on the stainless steel motor shaft and face plate (especially the seal seat area) with a non-metallic brush or scrub pad. Do not use a wire brush or steel wool.

8 Remove any dust created during step #7 above and put a few drops of non-petroleum lubricant around the face plate where the stationary seat is to be installed.

9 Install the new stationary seal seat into the faceplate by firmly pressing it down until it bottoms. The disk should be clean. If needed, wipe it with alcohol and a soft lint free cloth.

10 Replace the faceplate on the motor housing extension, being careful to avoid shaft contact. This may need to be gently tapped down until tight to the housing. Be sure to check that the stainless steel plate is flush to the extender plate face.

11 Install the special **installation tool** (item #180212-095) on the top of the shaft making sure it is tight to the flat base of the impeller to protect the seal from sharp edges during seal installation.

12 Apply a liberal amount of non-petroleum based lubricant on the outside of the special plastic **installation tool.**

13 Wipe any excess lubricant off of the stationary silicon carbide seal face with a lint free cloth and alcohol to ensure the surface is clean.

14 Install the new rotating seal element and spring assembly by gently pushing it (graphite ring first) over the **installation tool** and onto the shaft until the graphite ring presses tightly against the stationary seal seat. The seal spring may be compressed slightly.

15 Remove the **installation tool** from the shaft.

16 Install the impeller keeping the inlet end up. Make sure to align the flats to the shaft flats and push the impeller down tightly to the seal.

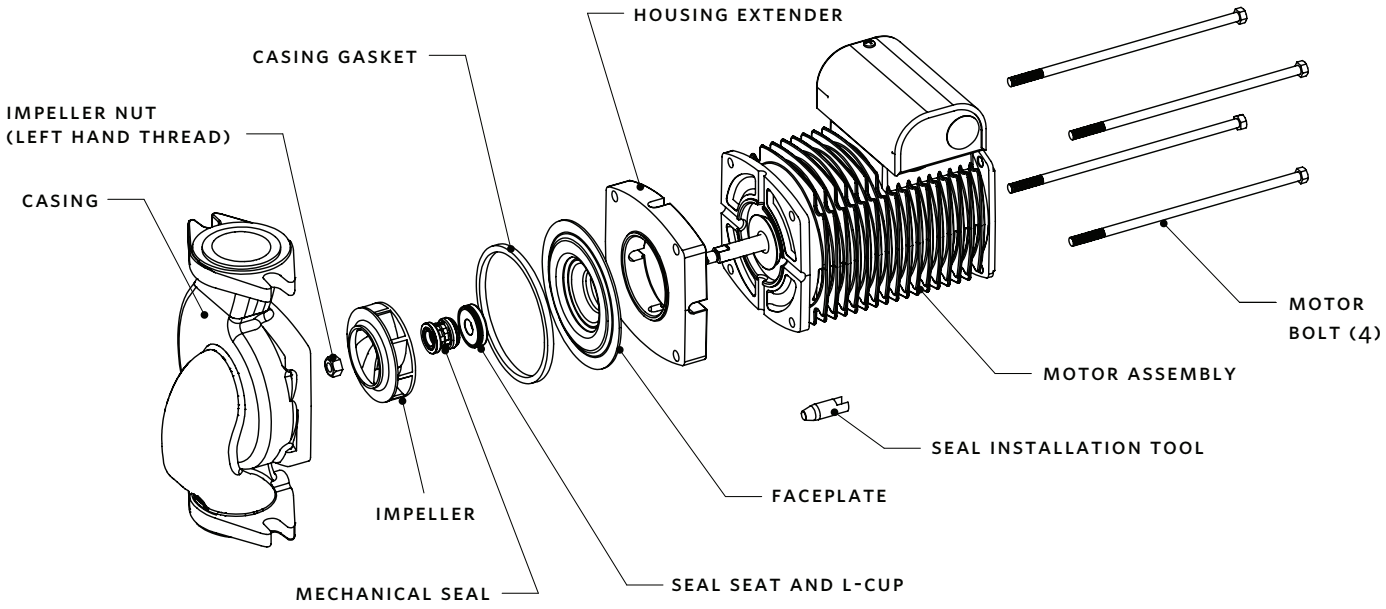
17 Place 2-3 drops of medium strength thread locker liquid on the nut threads.

18 Install the special left hand thread nut on the motor shaft. While holding the motor rotor in place as in step 3, thread the impeller nut on to the shaft in a counter-clockwise direction and tighten the nut to approximately 6ft-lbs.

19 If the impeller will not spin freely contact Armstrong Technical Support at 1-416-755-2291 or email techsupport@armlink.com.

20 Ensure the gasket is properly seated in the pump casing (volute) gasket groove. Holding the motor body, insert the impeller straight into the volute. Verify the gasket was not dislodged during insertion, and is still seated properly. Hold the motor body steady while fastening the four bolts that attach the motor to the pump casing (volute). Tighten evenly and diagonally. There should be a small, even gap of about 0.02" (0.5 mm) between the motor flange and the pump casing (volute).

21 Follow the **START UP** instructions (File no. 10.84) and check for leaks.



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ARMSTRONG

FILE NO.: 6010.28
DATE: April 21, 2009
SUPERSEDES: New
DATE: Feb. 23, 2006

Flange and Hardware Kit Part Numbers - Cast Iron

Cast Iron		Pipe Size and Part Number (for single flanges / flange kits)							Hardware	B&G Fastener	Hardware Kit details					
Model		0.75"	1"	1.25"	1.5"	2.0"	2.5"	3.0"	kit #	kit #	Qty	Gasket	Qty	Bolts	Qty	Nuts
Astro 20 / 30 / 50 / 70	Flange	116013-011	116012-011	116011-011	116009-011				810120-202	P15696	2	116653-000	4	911123-112	4	913523-100
	Flange kit	816013-111	816012-111	816011-111	816009-111											
E7 / E8 / E9 / E12 / E12-TE /	Flange	116013-011	116012-011	116011-011	116009-011				810120-244	P64910	2	105176-000	4	911123-112	4	913523-100
E14 / E14-TE / E15 / E17	Flange kit	816013-211	816012-211	816011-211	816009-211											
E10 / E11 / E13 / E19 / E21 /	Flange		106073-011	104300-011	104301-011				810120-204	P64940	2	104034-000	4	911123-114	4	913523-100
E22 / E23 / E24	Flange kit		806073-111	804300-111	804301-111											
E16	Flange					106074-011			810120-206	F91600	2	105209-002	8	911125-118	8	913125-100
	Flange kit					806074-111										
E28 / E29	Flange							105188-011	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
	Flange kit							805188-111								
E30 (2") / E33 (2")	Flange					106074-011			810120-212	N/A	2	116117-000	8	911125-118	8	913125-100
	Flange kit					806074-111										
E30 (3") / E33 (3")	Flange							105188-011	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
	Flange kit							805188-111								
H-32 BF	Flange		106073-011	104300-011	104301-011				810120-218	P64930	2	105176-001	4	911123-114	4	913523-100
	Flange kit		N/A	N/A	N/A											
H-41 BF	Flange		116012-011						810120-210	P64230	2	105176-000	2	911123-114	2	913523-100
	Flange kit		N/A													
H-51 BF	Flange		116012-011						810120-218	N/A	2	105176-001	4	911123-114	4	913523-100
	Flange kit		816012-211													
H-52 BF	Flange			116011-011					810120-218	P64910	2	105176-001	4	911123-114	4	913523-100
	Flange kit			816011-211												
H-53 BF	Flange				N/A				810120-218	P64930	2	105176-001	4	911123-114	4	913523-100
	Flange kit				816009-111											
H-54 BF	Flange					106074-011			810120-212	N/A	2	116117-000	8	911125-118	8	913125-100
	Flange kit					806074-111										
H-63 BF / H-64 BF / H-65 BF	Flange				104301-011				810120-204	N/A	2	104034-000	4	911123-114	4	913523-100
	Flange kit				804301-111											
H-66 BF / H-67 BF / H-68 BF	Flange					106074-011			810120-212	N/A	2	116117-000	8	911125-118	8	913125-100
	Flange kit					806074-111										
S-25 BF	Flange	116013-011	116012-011	116011-011	116009-011				810120-202	P15696	2	116653-000	4	911123-112	4	913523-100
	Flange kit	816013-111	816012-111	816011-111	816009-111											
S-35 BF	Flange					105210-011			810120-206	F91600	2	105209-002	8	911125-118	8	913125-100
	Flange kit					N/A										
S-45 BF	Flange						105189-011	105188-011	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
	Flange kit						N/A	N/A								
S-46 BF / S-55 BF / S-57 BF	Flange							105188-011	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
	Flange kit							N/A								
S-69 BF	Flange							133615-010	810120-214	P09540	2	105201-000	8	911129-120	8	913129-100
	Flange kit							N/A	(A hardware kit is included in each flange kit.)							

Flange and Hardware Kit Part Numbers - Bronze

Bronze		Pipe Size and Part Number (for single flanges / flange kits)							Hardware kit #	B&G Fastener kit #	Hardware Kit details					
Model		0.75"	1"	1.25"	1.5"	2.0"	2.5"	3.0"			Qty	Gasket	Qty	Bolts	Qty	Nuts
Astro 20B / 30B / 50B / 70B	Flange	116013-041	116012-041	116011-041	116009-041				810120-202	P15696	2	116653-000	4	911123-112	4	913523-100
	Flange kit	816013-141	816012-141	816011-141	816009-141											
E7B / E8B / E9B / E12B / E14B /	Flange	116013-041	116012-041	116011-041	116009-041				810120-244	P64910	2	105176-000	4	911123-112	4	913523-100
E12B-TE / E14B-TE / E15B / E1	Flange kit	816013-241	816012-241	816011-241	816009-241											
E10B / E11B / E13B / E19B /	Flange		106073-041	104300-041	104301-041				810120-204	P64940	2	104034-000	4	911123-114	4	913523-100
E21B / E22B / E23B / E24B	Flange kit		806073-141	804300-141	804301-141											
E16B	Flange					106074-041			810120-206	F91600	2	105209-002	8	911125-118	8	913125-100
	Flange kit					806074-141										
E28B / E29B								105188-041	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
								805188-141								
E30B (2") / E33B (2")	Flange					106074-041			810120-212	N/A	2	116117-000	8	911125-118	8	913125-100
	Flange kit					806074-141										
E30B (3") / E33B (3")								105188-041	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
								805188-141								
H-32 AB	Flange		106073-041	104300-041	104301-041				810120-218	P64930	2	105176-001	4	911123-114	4	913523-100
	Flange kit		N/A	N/A	N/A											
H-41 AB	Flange		116012-041						810120-210	P64230	2	105176-000	2	911123-114	2	913523-100
	Flange kit		N/A													
H-51 AB	Flange		116012-041						810120-218	N/A	2	105176-001	4	911123-114	4	913523-100
	Flange kit		816012-241													
H-52 AB	Flange			116011-041					810120-218	P64910	2	105176-001	4	911123-114	4	913523-100
	Flange kit			816011-241												
H-53 AB	Flange				N/A				810120-218	P64930	2	105176-001	4	911123-114	4	913523-100
	Flange kit				816009-141											
H-54 AB	Flange					106074-041			810120-212	N/A	2	116117-000	8	911125-118	8	913125-100
	Flange kit					806074-141										
H-63 AB / H-64 AB / H-65 AB	Flange				104301-041				810120-204	N/A	2	104034-000	4	911123-114	4	913523-100
	Flange kit				804301-141											
H-66 AB / H-67 AB / H-68 AB	Flange					106074-041			810120-212	N/A	2	116117-000	8	911125-118	8	913125-100
	Flange kit					806074-141										
S-25 AB	Flange	116013-041	116012-041	116011-041	116009-041				810120-202	P15696	2	116653-000	4	911123-112	4	913523-100
	Flange kit	816013-141	816012-141	816011-141	816009-141											
S-35 AB	Flange					105210-041			810120-206	F91600	2	105209-002	8	911125-118	8	913125-100
	Flange kit					N/A										
S-45 AB	Flange						105189-041	105188-041	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
	Flange kit						N/A	N/A								
S-46 AB / S-55 AB / S-57 AB	Flange							105188-041	810120-208	P65129	2	105201-000	8	911125-120	8	913125-100
	Flange kit							N/A								
S-69 AB	Flange							106466-041	810120-214	P09540	2	105201-000	8	911129-120	8	913129-100
	Flange kit							N/A	(A hardware kit is included in each flange kit.)							

810120-202 HARDWARE KIT

Part #	Description	Qty.	Pump Model
116653-000	gasket flange	2	S-25
911123-112	hhcs 7/16-14 x 1.5" lcs	4	Astro 20, Astro 30, Astro 50
913523-100	hh jam nut 7/16-14 lcs	4	

810120-204 HARDWARE KIT

Part #	Description	Qty.	Pump Model
104034-000	gasket flange	2	H-63, H-64, H-65
911123-114	hhcs 7/16-14 x 1.75" lcs	4	E10, E11, E13
913523-100	hh jam nut 7/16-14 lcs	4	

810120-206 HARDWARE KIT

Part #	Description	Qty.	Pump Model
105209-002	gasket flange	2	S-35
911125-118	hhcs 1/2-13 x 2.25" lcs	8	E16, E30, E33
913125-100	hh nut 1/2-13 lcs	8	

810120-208 HARDWARE KIT

Part #	Description	Qty.	Pump Model
105201-000	gasket flange	2	S-45, S-46
911125-120	hhcs 1/2-13 x 2.5" lcs	8	S-55, S-57
913125-100	hh nut 1/2-13 lcs	8	

810120-210 HARDWARE KIT

Part #	Description	Qty.	Pump Model
105176-000	gasket flange	2	H-41
911123-114	hhcs 7/16-14 x 1.75" lcs	4	
913523-100	hh jam nut 7/16-14 lcs	4	

810120-212 HARDWARE KIT

Part #	Description	Qty.	Pump Model
116117-000	gasket flange	2	H-54, H-66
911125-118	hhcs 1/2-13 x 2.25" lcs	8	H-67, H-68
913125-100	hh nut 1/2-13 lcs	8	4360-2B, 1050-2B

810120-214 HARDWARE KIT

Part #	Description	Qty.	Pump Model
105201-000	gasket flange	2	S-69
911129-120	hhcs 5/8-11 x 2-1/2" lcs	8	
913129-100	hh nut 5/8-11 unc	8	

810120-216 HARDWARE KIT

Part #	Description	Qty.	Pump Model
426410-008	gasket flange	2	1060-3D
911129-120	hhcs 5/8-11 x 2-1/2" lcs	8	
913129-100	hh nut 5/8-11 unc	8	

810120-218 HARDWARE KIT

Part #	Description	Qty.	Pump Model
105176-001	gasket flange	2	H-32, H-51, H-52, H-53
911123-114	hhcs 7/16-14 x 1.75" lcs	4	
913523-100	hh jam nut 7/16-14 lcs	4	4360-1.25B, 4360-1.5B, 4360-2B

810120-244 HARDWARE KIT

Part #	Description	Qty.	Pump Model
105176-000	gasket flange	2	
911123-112	hhcs 7/16-14 x 1.5" lcs	4	E7, E8, E9, E12, E14
913523-100	hh jam nut 7/16-14 lcs	4	

Circulator Flange Dimensions

Individual flanges								
Armstrong		Bell & Gossett		Dimensions				
Cast iron	Bronze	Cast iron	Bronze	A	B	C	D	Diagram
104300-011	104300-041	P03300	P06660	1 ¼"	3 7/16"	4 ¾"	½"	1
104301-011	104301-041	P03410	P06690	1 ½"	3 7/16"	4 ¾"	½"	1
105188-011	105188-041	F74000	F74800	3"	5 1/16"	6"	9/16"	2
105189-011	105189-041	P03560	P06750	2 ½"	5 1/16"	6"	9/16"	2
105210-011	105210-041	---	---	2"	3 ¾"	4 7/8"	9/16"	2
106073-011	106073-041	P01500	P06620	1"	3 7/16"	4 ¾"	½"	1
106074-011	106074-041	---	---	2"	3 5/32"	5 1/8"	5/8"	2
116009-011	116009-041	P03430	P03450	1 ½"	3 5/32"	4 ¼"	½"	1
116011-011	116011-041	P03250	P06640	1 ¼"	3 5/32"	4 ¼"	½"	1
116012-011	116012-041	P01510	---	1"	3 5/32"	4 ¼"	½"	1
116013-011	116013-041	P00740	---	¾"	3 5/32"	4 ¼"	½"	1
133615-010	106466-041	A24600	---	3"	6"	7 ½"	¾"	2

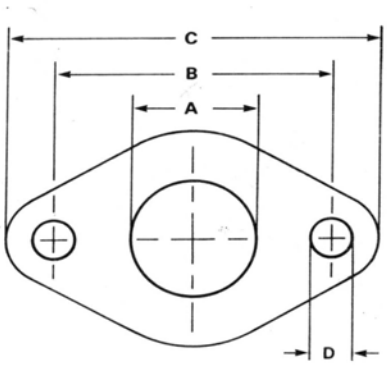

Diagram 1

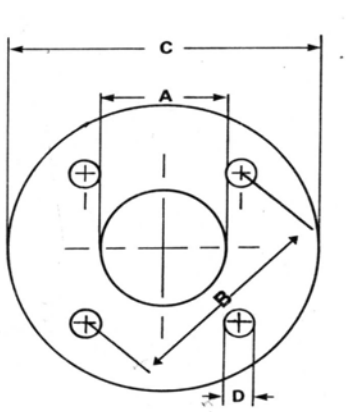

Diagram 2

ARMSTRONG FLUID TECHNOLOGY

Armstrong Pumps Inc.
("ARMSTRONG") TERMS OF SALE AND WARRANTY

File No: 9.10US
Date: SEPT. 02, 2014
Supersedes: 9.10US
Date: MAY 5, 2014

ARMSTRONG TERMS

The following terms shall prevail over and cancel any other or different terms or conditions proposed by a customer of Armstrong (the "Customer") through a purchase order or otherwise. Armstrong's acceptance of the Customer's order shall not be construed as an acceptance of printed or inserted provisions on the Customer 's form(s) which are inconsistent with or additional to these terms and conditions, unless specifically accepted in writing by an authorized signing officer of Armstrong. No sales representative, agent, or employee of Armstrong is authorized to alter, vary or waive any of these terms and conditions. Such changes require the written approval of an authorized signing officer of Armstrong.

ACCEPTANCE OF ORDERS

All orders are subject to formal acceptance at Armstrong's head office by an authorized signing officer of Armstrong.

PRICES

Unless otherwise expressly stated by Armstrong, prices quoted do not include any applicable transportation costs or property, sales, use, privilege or export taxes, custom duties or any other applicable tax, fee or charge imposed on or measured by the transaction(s) between the Customer and Armstrong. Customer will be responsible for paying such taxes, fees and costs, unless otherwise expressly stated by Armstrong. Prices quoted are firm for 30 days from date of quotation. [Upon acceptance, quoted] prices will remain firm to time of shipment, provided:

A Delivery is accepted as goods are available.

B The Customer will accept delivery six months or less from date of its order.

C Approval data is returned within 30 days from date of submission.

TERMS

Net 30 days from date of invoice, unless otherwise stated. The Customer will be charged the lesser of (i) 2% per month interest (24% per annum) or (ii) the highest rate permitted by law on all overdue accounts. These terms are subject to credit approval; otherwise, terms are cash with order or C.O.D.

MINIMUM BILLING

Minimum billing of each Customer order will be $150 net.

CONFIRMATION OF TELEPHONE ORDERS

Orders are accepted by telephone for the convenience of the Customer and must be promptly confirmed by Customer in writing. Such orders should be clearly marked as **Confirmation**; otherwise they may be duplicated.

RETURNED GOODS

No goods may be returned without first obtaining a Returned Goods (RG) number from Armstrong. Application [for RG number] must include invoice number and date of original shipment.

A All goods returned will be subject to a re-handling charge a minimum charge of the greater of 25% of invoice amount or $50.00 will apply.

B If, upon inspection, the goods are found to be in need of reconditioning or repair, an additional deduction will be made and the Customer will be advised of the total re-handling charge that will apply.

C All goods approved for return must be clearly tagged with RG number, have transportation charges prepaid and be received by Armstrong within 30 days of return approval and will be accepted for credit on the basis of original invoiced prices.

D Goods which are assembled to order [this includes all pumps, systems, heat exchangers and replacement tube bundles], obsolete, used, non-stock, or over 18 months old (from date of shipment), are not returnable.

WARRANTY

Armstrong warrants Armstrong-manufactured products to be free from defects in material and workmanship under normal use and service for the time periods noted below when installed and used in accordance with Armstrong's printed instructions [normal wear and tear excepted]:

- Design Envelope pumps and E.2 series circulators – 36 months from installation, but not more than 42 months from date of manufacture.
- Astro 2 and Compass circulators – 60 months from installation, but not more than 66 months from date of manufacture
- All other circulators and hydronic specialties - 24 months from installation, but not more than 30 months from date of manufacture.
- All other products - 12 months from installation, but not more than 18 months from date of manufacture.

Note: All mechanical seal warranties are restricted to those failures at start-up and must be reported in writing to the Armstrong factory within 48 hours. Armstrong obligations shall be limited

to the repair of parts or replacement of any part, at its option and F.O.B. factory (or F.O.B. authorized Armstrong service facility located in the Customer's territory where such facility is available and services the product in question), which may prove defective under normal use and service during the warranty period and which Armstrong's examination shall disclose to be defective. These warranties shall not apply to any goods which have been subject to accident, alteration, abuse, misuse, tampering, negligence, damage by flood, fire or act of God or where the goods have been improperly installed, maintained or subjected to certain types of and/or improperly applied with water treatment or other system additives. Armstrong shall not be liable for costs of removal, installation, service, labour or transportation charges or for damages for delay caused by defective material or workmanship or for personal injuries or damage to property caused directly or indirectly by any Armstrong-manufactured product or by its use or operation experienced by the Customer or any other person whatsoever.

The above warranties are in lieu of all other warranties expressed or implied. No representative or other person is authorized or permitted to make any warranty or assume for us any liability not strictly in accordance with the foregoing. The foregoing warranties shall not apply to components purchased by Armstrong from other manufacturers; in lieu of providing warranty on such components, Armstrong will make available to the customer any warranties received by it from such manufacturers. Customer must pursue any remedy with respect to such components against such third party. Other than the foregoing warranties, Armstrong makes no representation or warranty of any kind, expressed or implied, with respect to its products, whether as to merchantability, fitness for a particular purpose or any other matter. The customer acknowledges that it uses any products provided by Armstrong for business purposes and therefore agrees that all consumer protection terms implied by law shall not apply.

SHIPMENT (F.O.B. POINT), RISK OF LOSS, TITLE

Prices are F.O.B. Armstrong's warehouse, unless otherwise stated. Where freight allowances are specifically offered, Armstrong reserves the right to select carrier and routing. All deliveries and shipments will be at the Customer's risk from the time of delivery to the carrier by Armstrong, irrespective of whether the principal carrier shall have been designated in the shipping instructions of the Customer. The Customer is required to inspect all inbound documents for accuracy. If there is any evidence of injury to or shortage of containers' contents, the Customer shall not provide receipt to carrier in good condition, but shall give receipt according to the facts. In case of damage, claim must be made on carrier without delay. Armstrong's assistance is available to secure adjustment. Any discrepancy must be reported in writing to Armstrong Customer Service within 5 days of receipt. Title to products will pass to Customer upon Armstrong's receipt of the entire purchase price therefor.

PRIOR SALE

Goods in stock are offered subject to prior sales or shipment.

SHIPMENT, DELIVERIES OR CANCELLATIONS

Shipment dates are estimated and Armstrong will not be liable for late shipments. Armstrong shall not be liable for any charges or damages arising directly or indirectly, out of loss, damage, stoppage or delay and interruption with respect to shipments or to delivery schedules resulting from fire, storm, flood, war, explosion, accident, strike, lockout, labour disturbance, embargos, riots, acts of civil or military authority, acts or omissions of the Customer or acts of God or public enemies, inability to obtain product from supplier, accident or breakdown to, or mechanical failure of, machinery and equipment, changes in economic conditions or other causes beyond Armstrong's reasonable control. If shipments are delayed or deferred by the Customer more than one month beyond the original shipping date, payment for goods shall become due at the time and storage or warehousing charges of the lesser of (i) 2% per month (24% per annum) or (ii) the highest rate permitted by law. No order for assembled to order equipment may be cancelled, materially altered or terminated except upon payment to Armstrong for loss, damage and expense arising from such cancellation, alteration or termination, including a reasonable profit and overhead. Armstrong reserves the right to discontinue the sale of certain of its products and to change the contents and packaging thereof. Armstrong shall not incur any liability thereby or any obligation to change or repurchase any such products sold to the Customer.

LIMITATION OF LIABILITY

Notwithstanding anything to the contrary herein contained, Armstrong shall not be liable to Customer or any third party for any consequential, contingent, incidental, liquidated, indirect or special damages, lost profits or other losses of customer or any third party arising, directly or indirectly, in respect of any products or services provided by Armstrong to the Customer or the sale, transportation, use or failure thereof, whether based on breach of warranty, negligence or otherwise. Without limiting the generality of the foregoing, the parties acknowledge and agree that: (a) Armstrong shall not be liable for any damages which result from the Customer's failure to take reasonable steps to maintain and inspect the products provided by Armstrong and their related components or failure to have appropriate standby procedures in place in relation thereto, (b) Armstrong shall not be liable for any damages arising, directly or indirectly, in respect of any components provided to the Customer by Armstrong which were purchased by Armstrong from other manufacturers or the use or failure thereof and (c) Armstrong's maximum liability to the customer shall be limited to the replacement value of any products provided by Armstrong to the Customer.

STATUTE OF LIMITATIONS

Any action of any nature by Customer against Armstrong must be commenced by Customer within one year after the cause of action first accrued.

DEFAULT

If Customer (a) fails to pay any amount due to Armstrong when due, (b) fails to observe or perform any of its other obligations under these terms and conditions, (c) takes any action that in Armstrong's opinion adversely affects the name, reputation or goodwill of Armstrong or its products, (d) is an entity and the person(s) that controls Customer on the date these terms and conditions are issued to Customer no longer controls Customer or (e) becomes insolvent, is adjudicated a bankrupt, voluntarily files or permits the filing of a petition in bankruptcy, makes an assignment for the benefit of creditors, seeks any similar relief under any bankruptcy laws or related statutes or a receiver is appointed for its assets, then, at Armstrong's sole option, all sums due or to become due from Customer to Armstrong may become immediately due and payable, and concurrently, or in the alternative, Armstrong may terminate any existing order between the Parties in whole or in part, defer shipment or delivery of any products, sell any part of any undelivered products and exercise any other remedies available to Armstrong under applicable law.

COSTS AND EXPENSES; INDEMNIFICATION

Customer will be responsible for all costs and expenses, including attorneys' fees and disbursements, incurred by Armstrong in enforcing any term or condition herein and Customer will indemnify and promptly reimburse Armstrong for such costs and expenses. Customer agrees to indemnify and hold the Armstrong and its officers, directors, employees, agents, affiliates and customers harmless from all costs, expenses and losses incurred by any of them which relate to or arise out of Customer's or Customer's customers use, transportation, handling, installation, sale, distribution or disposal of any products sold hereunder or Customer's failure to perform any obligation hereunder.

[CONFIDENTIAL INFORMATION

Armstrong's technical, trade secret, proprietary or similar information (collectively, "Confidential Information") disclosed by Armstrong to Customer or its officers, directors, employees or agents (collectively, "Representatives") and all copies thereof are the sole and exclusive property of Armstrong. Such disclosure will not be construed as granting to Customer or its Representatives any right, title or interest of any kind in any Confidential Information. Upon Armstrong's request, Customer will promptly deliver to Armstrong all Confidential Information in Customer's possession which is in written or electronically-readable form, including all copies or extracts thereof or based thereon in its possession or in the possession of any of its Representatives. All Confidential Information will be kept confidential by Customer and will not be disclosed to any person or entity without Armstrong prior written consent. Customer will be responsible for any breach of this covenant by Customer or any of Customer's Representatives and will indemnify Armstrong and its officers, directors, employees, agents, affiliates and customers for any costs, expenses or losses incurred or suffered by any of them as a result of such breach.]

TERRITORIAL RESTRICTIONS

The Customer shall not without the express written approval of Armstrong (which shall not be unreasonably withheld) export or use any products provided by Armstrong, or sell or hire such products to a person or entity who to its knowledge intends to export or use it, outside the country of intended use as declared to Armstrong. The Customer undertakes to comply with export control restrictions where applicable. If export or import restrictions are imposed or export or import licenses are cancelled, withdrawn or not renewed, then the Customer shall pay for all goods already delivered at the contract rate and payments already made may be used by Armstrong in respect of claims or demands made or losses incurred hereunder.

SECURITY INTEREST

Customer hereby grants to Armstrong a priority lien and security interest in products sold to Customer and in all proceeds of such products to secure Customer's obligations to Armstrong hereunder. Customer appoints each officer of Armstrong as an attorney-in-fact for Customer for the purpose of executing and filing each financing statement or other documents necessary to perfect such security interest. Upon the failure of Customer to pay the purchase price for any products when due, or to perform any of Customer's obligations under these terms and conditions, Armstrong will (a) without any judicial process, have the right to enter upon Customer's premises and take possession of any such products or to receive such products from Customer upon Armstrong's demand and (b) have all other rights and remedies of a secured party under the Uniform Commercial Code of the [State of New York] and any other applicable law.

GOVERNING LAW; JURISDICTION; VENUE:

Armstrong's offer, sales contract, invoice, these terms and conditions, Armstrong's order acknowledgment and any other document delivered by Armstrong to Customer will be governed by and construed according to the laws of the [State of New York], without reference to the principles of conflicts of law. Armstrong and Customer each hereby irrevocably and unconditionally (a) consents to submit to the exclusive jurisdiction of the United States District Court for the [Western District of New York] or the applicable state court located in the State of New York, [County of Erie] for any action or proceeding arising out of or relating to the

sale of Armstrong's products to Customer, (b) waives any objection to the laying of venue of any such action or proceeding in such courts and (c) waives and agrees not to plead or claim in any such court that any such action or proceeding brought in any such court has been brought in an inconvenient forum.

MISCELLANEOUS

It is understood that neither party hereto is constituted as an agent, employee or servant of the other party for any purpose whatsoever. The Customer shall be solely responsible for its acts, conduct and expenses and the acts, conduct and expenses of its employees and agents. These terms and conditions will be binding upon the Parties and their respective successors and assigns; provided, however, that Customer may not assign any of its rights or duties hereunder without Armstrong's prior written consent. If any of the provisions of these terms and conditions are held by a court or other tribunal of competent jurisdiction to be unenforceable, the remaining provisions of these terms and conditions will remain in full force and effect. Armstrong's offer, sales contract or invoice, these terms and conditions and Armstrong's order acknowledgement constitute the entire agreement between Armstrong and the Customer with respect to the sale of Armstrong's products to Customer, superseding all prior representations, agreements or understandings, written or oral, between the parties with respect to such sale. These terms and conditions cannot be amended orally or by any course of conduct by either party, but may only be amended by a written agreement executed by the Parties. The failure by Armstrong to (a) enforce any provision hereof will not be construed as a waiver of such provision or of Armstrong's right to enforce such provision and (b) object to provisions contained in any purchase order or other communication from Customer will not be construed as a waiver of these terms and conditions nor an acceptance of any such Customer provisions.

ACCEPTANCE

The Customer's acceptance of any goods supplied by Armstrong or on Armstrong's behalf shall without limitation constitute acceptance of all terms and conditions as stated herein.

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KELLY WALSH HIGH SCHOOL
Tag: PHX 5-6 Model # Compass 20-20 CI FLG
Part # 180203-606

ARMSTRONG

COMPASS | HIGH-EFFICIENCY WET-ROTOR CIRCULATORS |
INSTALLATION AND OPERATING INSTRUCTIONS

File No: 10.895
Date: MARCH 28, 2014
Supersedes: 10.895
Date: DECEMBER 10, 2013

WARNING

- Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.
- The use of this product requires experience with and knowledge of the product. Only licensed or trained installers should install this product.
- For supply Connection, use wires acceptable for at least 90°C (194°F).
- **Risk of shock:** this pump has not been tested for use in swimming pools or marine areas.
- To reduce risk of electric shock: Unplug before servicing, see instructions for proper installation, connect to a properly grounded, grounding type receptacle only.
- For indoor use only.
- Use copper conductors only.
- Do not install with motor above or below pump body.
- Do not submerge.
- Do not run pump dry.

1.0 SYMBOLS USED IN THIS DOCUMENT

WARNING

The safety instructions must be followed to prevent potential personal injury.

CAUTION

The safety instructions must be followed to prevent potential malfunction or damage to the equipment.

HINT

Hints or instructions that make the setup easier and ensure safe operation

2.0 GENERAL INSTALLATION

2.1 THE ARMSTRONG COMPASS CIRCULATOR

The Armstrong Compass circulator is designed for circulating water in closed hydronic heating systems or potable water systems.

Model

- Compass 20-20 CI
- Compass 20-20 SS**

The Armstrong Compass includes operating modes suitable for systems with constant or variable flows, such as:

- Underfloor heating systems
- One-pipe (series) systems
- Two-pipe (parallel) systems

Armstrong Compass circulators incorporate Armstrong patented Design Envelope variable speed control technology with an ECM motor, enabling optimum energy efficiency and occupant comfort, with built-in control algorithms that can adapt to continuously changing system requirements.

The Armstrong Compass features a user-friendly front-mounted control panel (see section 6) and wiring box for ease of installation.

2.2 BENEFITS OF INSTALLING AN ARMSTRONG COMPASS CIRCULATOR

Eight different modes of operation to suit different system requirements:

- Easily selectable from the front mounted display.
- Modes include Sensorless demand-based control – Auto.
- Power consumption and flow rate clearly displayed.

Broad operating range, producing up to 20 feet of head and 20 US GPM of flow, provide versatility to cover the performance of a wide range of fixed speed or variable speed circulators.

- Flange to flange compatibility with existing Armstrong circulators and many competing models.

Front mounted wiring box for ease of installation and service.

3.0 INSTALLATION

3.1 MOUNTING

Note:
For convenience in future servicing, isolation flanges can be used in place of standard flanges.

CORRECT INSTALLATIONS **INCORRECT INSTALLATIONS**

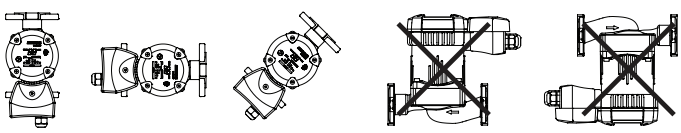

FIG. 2 Mounting the Armstrong compass

Arrows on the pump housing indicate the liquid flow direction through the pump.

1. Fit the two gaskets supplied when the pump is mounted in the pipe.
2. Install the pump with the motor shaft horizontal (see **FIG. 2**).

3.2 CONTROL BOX POSITIONS

The orientation of the display can be adjusted by removing four screws that attach the motor to the pump housing. Pump must be isolated from the system as this will open the system to the atmosphere.

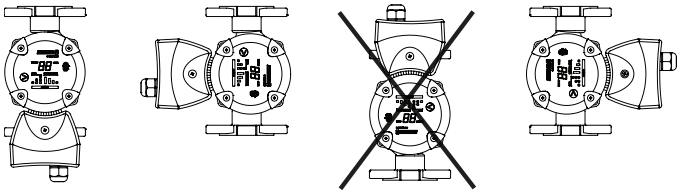

FIG. 3 Control box positions

WARNING

The pumped liquid may be scalding hot and under high pressure. Drain the system or close the isolating valves on either side of the pump before the screws are removed.

CAUTION

After the position of the control box has been rotated, refill the pump with system liquid before startup.

3.3 CHANGING THE WIRING BOX POSITION

Always install the circulator with the wiring box below or beside the motor. To change the wiring box position, remove the motor mounting screws and rotate the motor (see **FIG. 3**).

Ensure the gasket is intact and seated before evenly retightening the mounting screw to 4.5 - 5.5 lb/ft (6 - 7.5 Nm).

4.0 ELECTRICAL CONNECTION

The electrical wiring must be installed strictly in accordance with national electrical codes, local codes and regulations.

1. Electrical installation should be conducted by a qualified electrician.
2. Always make sure electric power is disconnected before wiring the circulator.

The motor is designed for 60 Hz, 1 phase, 115 volt power.

Wire shall be 14 to 16 gauge solid wire or 16 to 18 gauge stranded wire.

To wire, loosen the screw from the wiring box cover and remove the screw and cover.

Insert wires through supplied liquid-seal connector (installed) or other strain relief connector (not provided).

Select to use the installed liquid-seal connector or included ½" NPT connector. To install the NPT connector, loosen the existing connector and screw on the NPT connector using the existing lock nut.

(Connect other strain relief connector (not provided)to the NPT connector.)

Insert wires through the connector(s).

Strip 3⁄16" of insulation from the ends of the three wires to be connected.

To insert the wires into the terminal strip, press the terminal lever downward firmly. Insert the stripped wire into the opening and release the lever (see **FIG. 4**). Tug on the wire gently to ensure it is secured.

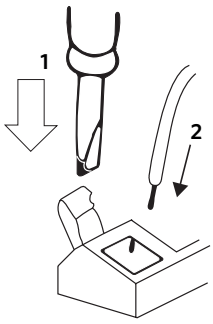

FIG. 4 Terminal strip

Connect the hot wire to terminal 'L', the neutral wire to terminal 'N', and the ground wire to terminal ⏚ (see **FIG. 5**).

Place the terminal box cover and tighten screw.

The motor is thermally protected so overload protection is not necessary. All that is required is a fused plug or circuit breaker in the power line. Electrical information can be found on the side of the terminal box.

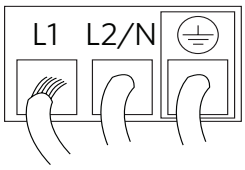

FIG. 5 Electrical connection

The electrical connections and protection must be carried out in accordance with local regulations.

WARNING

The pump must be connected to ground.

5.0 CONTROL PANEL

5.1 ELEMENTS ON THE CONTROL PANEL

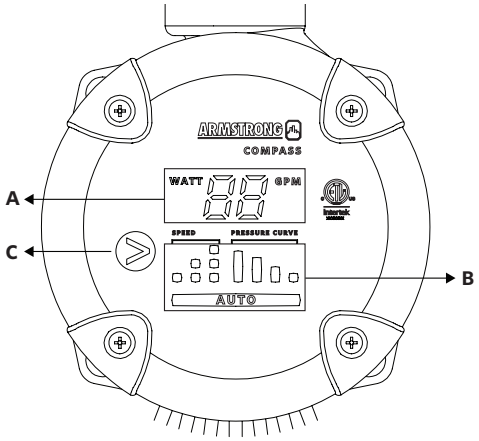

FIG. 6 Armstrong compass control panel

The control panel on the Armstrong compass includes:

POSITION	DESCRIPTION
A	Display showing the actual pump power consumption in Watt and reference flow in USgpm. Display alternates between Watt and GPM every 5 seconds.
B	Eight light fields indicating the pump setting
C	**Mode Select** button for changing pump setting

Note

GPM value is a flow indicator only, not calibrated.

5.2 FIRST POWER-UP

The display is on and in Auto mode (position 0 in **FIG. 7**) when the electricity has been switched on.

The display shows the actual pump power consumption in Watts and reference flow in USgpm during operation.

Note

Display shows "E#" when the pump is not operating properly (see section 10). (# is between 0 to 4)

5.3 DISPLAY

The Armstrong Compass has eight pump settings which can be selected with the press button.

Every time the Mode button is pressed (see **FIG. 6**, **C**) the pump setting is changed to the next option.

A full cycle is eight button presses.

The selected pump setting is indicated by one of eight different light fields (see **FIG. 7**).

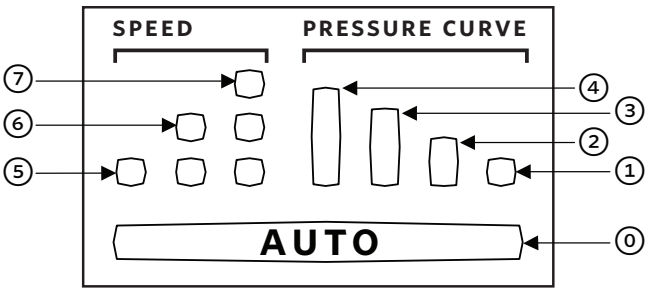

FIG. 7 Eight light fields

See section 9, Pump settings and pump performance, for information about the function of each setting.

POSITION	DESCRIPTION
⓪	AUTO (factory setting)
①	PC1 Lowest proportional-pressure curve
②	PC2 Highest proportional-pressure curve
③	PC3 Lowest constant-pressure curve
④	PC4 Highest constant-pressure curve
⑤	Constant curve, speed I
⑥	Constant curve, speed II
⑦	Constant curve, speed III

6.0 SETTING THE PUMP

6.1 PUMP SETTING FOR SYSTEM TYPE

Note
Optimum energy savings & comfort can be achieved by careful selection of the correct operation mode.

Recommended and alternative pump settings according to **FIG. 8**:

IMAGE	SYSTEM TYPE	RECOMMENDED SETTING	ALTERNATIVE SETTING
A	Underfloor heating	**AUTO**	Highest constant-pressure curve (PC4)* OR Lowest constant-pressure curve (PC3)*
B	Two-pipe (parallel) systems	**AUTO**	Highest proportional-pressure (PC2)*
C	One-pipe (series) systems	Lowest proportional-pressure curve (PC1)*	Highest proportional-pressure (PC2)*

* See pump settings and pump performance (section 9).

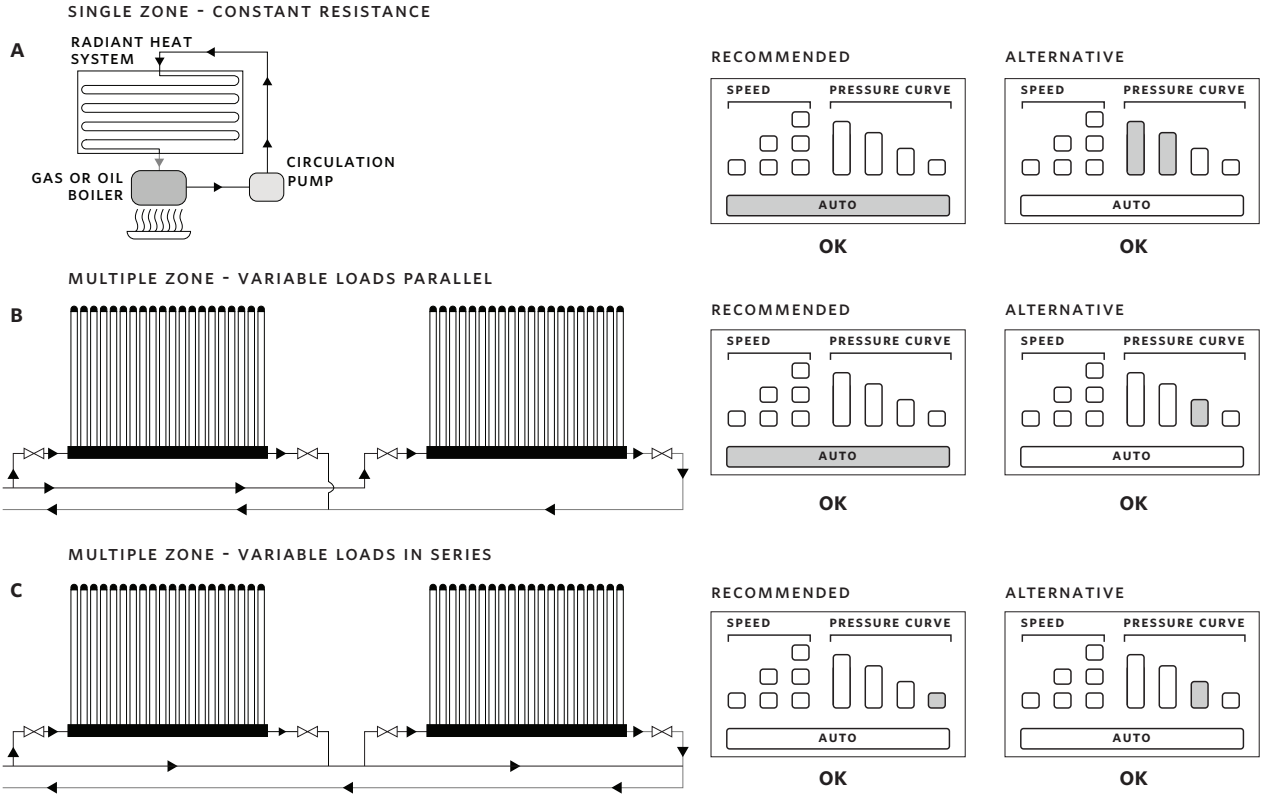

FIG. 8 Selection of pump setting for system type

AUTO (underfloor heating and two-pipe (parallel) systems)
AUTO function observes and adjusts the pump performance to satisfy the system requirement. The pump adapts to the system over time, it is recommended to leave the pump in the **AUTO** position at least one week before selecting other pump settings.

Changing from recommended (AUTO) to alternative pump setting:
Heating systems are 'slow' systems that cannot be set to the optimum operation within minutes or hours.

If the recommended pump setting does not give the desired comfort in some areas of the building, change the pump setting to the shown alternative.

See pump settings and pump performance (section 9) for more details.

7.0 SYSTEMS WITH BYPASS VALVE BETWEEN FLOW AND RETURN PIPES

7.1 PURPOSE OF BYPASS VALVE

The purpose of a differential pressure bypass valve is to ensure that the heat from the boiler can be distributed when all valves in the underfloor-heating circuits and/or thermostatic radiator valves are closed. These valves were commonly applied in multi zone systems with traditional fixed speed pumps.

A Compass circulator can eliminate the need for a differential bypass valve when used in Auto or proportional pressure modes, because the circulator will reduce speed when the valves in the system close and the heat demand is reduced.

If you are servicing an existing system with a bypass valve and you are replacing a fixed speed circulator with a Compass circulator, there is no need to remove the bypass valve.

8.0 START-UP

8.1 BEFORE START-UP

Fill the system with liquid and properly vent the system before starting the pump. The required minimum inlet pressure in relation to liquid temperature must be available at the pump inlet (see section 11).

8.2 VENTING THE PUMP

Even with system vented, air may be still be present in the pump. The air in the pump may cause noise but the noise should cease after a few minutes running.

The venting process can be shortened by setting the pump to run at speed III for a short period of time (20 seconds).

Once the pump is vented (the noise has ceased), set the pump mode according to the recommendations (see section 6).

CAUTION

The pump must not run dry.

9.0 PUMP SETTINGS AND PUMP PERFORMANCE

9.1 RELATION BETWEEN PUMP SETTING AND PUMP PERFORMANCE

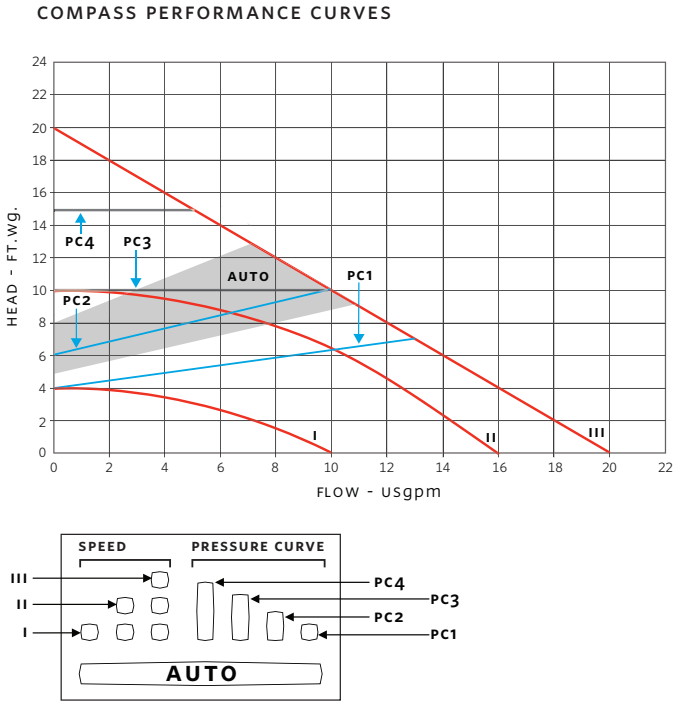

FIG. 10 Pump setting in relation to pump performance

Select the optimum setting:

The Compass circulator comes with 8 modes of operation.

There are three fixed speed curve options which will operate just like traditional fixed speed circulators, except that compass motor technology is far more energy efficient than traditional fixed speed circulators.

The proportional pressure curves operate as Sensorless differential pressure circulators. These curves follow pre-selected performance curves and will reduce flow and energy consumption when the valves in the system close and the flow requirements are reduced.

The constant pressure curves maintain pre-selected pressure ratings at the circulator.

AUTO mode operates on the sensorless differential pressure principle, but will **Learn** usage patterns and adjust circulator performance over time to optimize energy efficiency.

SETTING	PUMP CURVE	FUNCTION
AUTO (factory setting)	Operating within the defined range	The **AUTO** function controls the pump performance automatically within a defined performance range (see **FIG. 10**). • Adapt to the size of the system. • Adapt to system demand over time. In **AUTO**, Compass is set to proportional-pressure curve control.
PC1	Lowest proportional pressure curve	The operation point of the pump will follow the lowest proportional-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is reduced during low demand and increased during high demand until the maximum wattage is reached, then the pump will run on the speed III curve.
PC2	Highest proportional pressure curve	The operation point of the pump will follow the highest proportional-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is reduced during low demand and increased during high demand until the maximum wattage is reached, then the pump will run on the speed III curve.
PC3	Lowest constant pressure curve	The operation point of the pump will follow the lowest constant-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is kept constant, regardless of the load demand until the maximum wattage is reached, then the pump will run on the speed III curve.
PC4	Highest constant pressure curve	The operation point of the pump will follow the highest constant-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is kept constant, regardless of the load demand until the maximum wattage is reached, then the pump will run on the speed III curve.
III	Speed III	Speed III is the highest constant speed performance curve of Compass and it also presents the max performance capability of the pump (see **FIG. 10**). Speed III can also be used to vent the pump (see section 8.2).
II	Speed II	Speed II is the medium constant speed performance curve of Compass (see **FIG. 10**).
I	Speed I	Speed I is the lowest constant speed performance curve of Compass (see **FIG. 10**).

10.0 TROUBLESHOOTING

WARNING

Before starting any work on the pump, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

FAULT	CONTROL PANEL	CAUSE	REMEDY
The pump does not run	Light off	A fuse in the installation is blown.	Replace the fuse.
		The circuit breaker has tripped out.	Switch the circuit breaker on.
		The pump is defective.	Replace the pump.
	Shows "E0" or "E1"	Electricity supply failure. Voltage may be too low or too high.	Check voltage level of the electricity supply.
	Shows "E2"	The impeller is locked.	Unlock the impeller/rotor.
	Shows "E3"	No liquid in system	Fill up the system
	Shows "E4"	Voltage may be too low	Check voltage level of the electricity supply.
		Control (internal circuit) is broken	Replace the pump.
Noise in the system	Shows wattage and gpm	Air in the system.	See section 8.2 Venting of the pump system.
		The flow is too high.	Select a lower speed or pressure curve (see section 9). Pump settings and pump performance.
		Pump may be running dry. No liquid in system	Fill up the system
Noise in the pump	Shows wattage and gpm	Air in the pump.	Let the pump run. It vents itself over time (see section 8.2) venting the pump.
		The inlet pressure is too low.	Increase the inlet pressure or check the air volume in the expansion tank, if installed.
Insufficient heat in space	Shows wattage and gpm	The pump performance setting may be too low.	Select a higher speed or pressure curve setting (see section 9). Pump settings and pump performance.
			Confirm that the system requirement can be met by this pump capacity or larger pump may be required.

11.0 TECHNICAL DATA AND INSTALLATION DIMENSIONS

11.1 TECHNICAL DATA

Supply voltage: 1 × 115 V – 10%/+ 6%, 60 Hz

	MINIMUM	MAXIMUM
Amp	0.05	0.65
Watt	5	45

Motor protection: The pump requires no external motor protection.

Maximum working temperature: 230°F (110°C) maximum

Maximum working pressure: 150 psi (10 bar).

Maximum relative air humidity (rh): 95%.

Enclosure class: Type 2

Insulation class: H

Certification: ETL listed for US and Canada (conforms to ULSTD.778 certified to CSA STD. C22.2 NO.108-01)

** NSF 372 (for stainless steel models)

INLET PRESSURE

Minimum inlet pressure in relation to liquid temperature:

LIQUID TEMPERATURE	MINIMUM INLET PRESSURE
150°F (65°C)	3.0 ft (0.91 m)
167°F (75°C)	4.4 ft (1.34 m)
194°F (90°C)	9.2 ft (2.8 m)
230°F (110°C)	36.1 ft (11.0 m)

Sound pressure level: The sound pressure level of the pump is lower than 43 dB(A).

Ambient temperature: 32°F (0°C) – 104°F (40°C)

Pumped liquids: Water or water Glycol mix.

WARNING

No flammable liquids such as diesel oil, petrol or similar liquids

Liquid temperature: 36°F (2°C) – 230°F (110°C)

To avoid condensation in the control box and stator, the liquid temperature must always be higher than the ambient temperature.

AMBIENT TEMPERATURE	LIQUID TEMPERATURE	
	MIN.	MAX.
32°F (0°C)	35.6°F (2°C)	230°F (110°C)
50°F (10°C)	50°F (10°C)	230°F (110°C)
68°F (20°C)	68°F (20°C)	230°F (110°C)
86°F (30°C)	86°F (30°C)	230°F (110°C)
95°F (35°C)	95°F (35°C)	194°F (90°C)
104°F (40°C)	104°F (40°C)	158°F (70°C)

CAUTION

Since water conditions can vary with geographical location (i.e. amount and type of dissolved solids) it is recommended that the operating temperature of the liquid for open (potable) systems be kept as low as possible (i.e. below 150°F or 65°C) to avoid precipitation of calcium.

VOLUTE MATERIAL

Cast iron: For closed systems (boiler loops)

Stainless steel:** Open or closed systems (potable hot water or boiler loops)

** Certified <0.25 weighted average percent lead (NSF 372) and complies with California Health and Safety code section 116875 (commonly known as AB1953).

SPARE PARTS

SPARE PART	ITEM NO.
Check valve 1"	810223–104

ARMSTRONG FLUID TECHNOLOGY

Armstrong Pumps Inc.
("ARMSTRONG") TERMS OF SALE AND WARRANTY

File No: 9.10US
Date: SEPT. 02, 2014
Supersedes: 9.10US
Date: MAY 5, 2014

ARMSTRONG TERMS

The following terms shall prevail over and cancel any other or different terms or conditions proposed by a customer of Armstrong (the "Customer") through a purchase order or otherwise. Armstrong's acceptance of the Customer's order shall not be construed as an acceptance of printed or inserted provisions on the Customer 's form(s) which are inconsistent with or additional to these terms and conditions, unless specifically accepted in writing by an authorized signing officer of Armstrong. No sales representative, agent, or employee of Armstrong is authorized to alter, vary or waive any of these terms and conditions. Such changes require the written approval of an authorized signing officer of Armstrong.

ACCEPTANCE OF ORDERS

All orders are subject to formal acceptance at Armstrong's head office by an authorized signing officer of Armstrong.

PRICES

Unless otherwise expressly stated by Armstrong, prices quoted do not include any applicable transportation costs or property, sales, use, privilege or export taxes, custom duties or any other applicable tax, fee or charge imposed on or measured by the transaction(s) between the Customer and Armstrong. Customer will be responsible for paying such taxes, fees and costs, unless otherwise expressly stated by Armstrong. Prices quoted are firm for 30 days from date of quotation. [Upon acceptance, quoted] prices will remain firm to time of shipment, provided:

A Delivery is accepted as goods are available.

B The Customer will accept delivery six months or less from date of its order.

C Approval data is returned within 30 days from date of submission.

TERMS

Net 30 days from date of invoice, unless otherwise stated. The Customer will be charged the lesser of (i) 2% per month interest (24% per annum) or (ii) the highest rate permitted by law on all overdue accounts. These terms are subject to credit approval; otherwise, terms are cash with order or C.O.D.

MINIMUM BILLING

Minimum billing of each Customer order will be $150 net.

CONFIRMATION OF TELEPHONE ORDERS

Orders are accepted by telephone for the convenience of the Customer and must be promptly confirmed by Customer in writing. Such orders should be clearly marked as **Confirmation**; otherwise they may be duplicated.

RETURNED GOODS

No goods may be returned without first obtaining a Returned Goods (RG) number from Armstrong. Application [for RG number] must include invoice number and date of original shipment.

A All goods returned will be subject to a re-handling charge a minimum charge of the greater of 25% of invoice amount or $50.00 will apply.

B If, upon inspection, the goods are found to be in need of reconditioning or repair, an additional deduction will be made and the Customer will be advised of the total re-handling charge that will apply.

C All goods approved for return must be clearly tagged with RG number, have transportation charges prepaid and be received by Armstrong within 30 days of return approval and will be accepted for credit on the basis of original invoiced prices.

D Goods which are assembled to order [this includes all pumps, systems, heat exchangers and replacement tube bundles], obsolete, used, non-stock, or over 18 months old (from date of shipment), are not returnable.

WARRANTY

Armstrong warrants Armstrong-manufactured products to be free from defects in material and workmanship under normal use and service for the time periods noted below when installed and used in accordance with Armstrong's printed instructions [normal wear and tear excepted]:

- Design Envelope pumps and E.2 series circulators – 36 months from installation, but not more than 42 months from date of manufacture.
- Astro 2 and Compass circulators – 60 months from installation, but not more than 66 months from date of manufacture
- All other circulators and hydronic specialties - 24 months from installation, but not more than 30 months from date of manufacture.
- All other products - 12 months from installation, but not more than 18 months from date of manufacture.

Note: All mechanical seal warranties are restricted to those failures at start-up and must be reported in writing to the Armstrong factory within 48 hours. Armstrong obligations shall be limited

to the repair of parts or replacement of any part, at its option and F.O.B. factory (or F.O.B. authorized Armstrong service facility located in the Customer's territory where such facility is available and services the product in question), which may prove defective under normal use and service during the warranty period and which Armstrong's examination shall disclose to be defective. These warranties shall not apply to any goods which have been subject to accident, alteration, abuse, misuse, tampering, negligence, damage by flood, fire or act of God or where the goods have been improperly installed, maintained or subjected to certain types of and/or improperly applied with water treatment or other system additives. Armstrong shall not be liable for costs of removal, installation, service, labour or transportation charges or for damages for delay caused by defective material or workmanship or for personal injuries or damage to property caused directly or indirectly by any Armstrong-manufactured product or by its use or operation experienced by the Customer or any other person whatsoever.

The above warranties are in lieu of all other warranties expressed or implied. No representative or other person is authorized or permitted to make any warranty or assume for us any liability not strictly in accordance with the foregoing. The foregoing warranties shall not apply to components purchased by Armstrong from other manufacturers; in lieu of providing warranty on such components, Armstrong will make available to the customer any warranties received by it from such manufacturers. Customer must pursue any remedy with respect to such components against such third party. Other than the foregoing warranties, Armstrong makes no representation or warranty of any kind, expressed or implied, with respect to its products, whether as to merchantability, fitness for a particular purpose or any other matter. The customer acknowledges that it uses any products provided by Armstrong for business purposes and therefore agrees that all consumer protection terms implied by law shall not apply.

SHIPMENT (F.O.B. POINT), RISK OF LOSS, TITLE

Prices are F.O.B. Armstrong's warehouse, unless otherwise stated. Where freight allowances are specifically offered, Armstrong reserves the right to select carrier and routing. All deliveries and shipments will be at the Customer's risk from the time of delivery to the carrier by Armstrong, irrespective of whether the principal carrier shall have been designated in the shipping instructions of the Customer. The Customer is required to inspect all inbound documents for accuracy. If there is any evidence of injury to or shortage of containers' contents, the Customer shall not provide receipt to carrier in good condition, but shall give receipt according to the facts. In case of damage, claim must be made on carrier without delay. Armstrong's assistance is available to secure adjustment. Any discrepancy must be reported in writing to Armstrong Customer Service within 5 days of receipt. Title to products will pass to Customer upon Armstrong's receipt of the entire purchase price therefor.

PRIOR SALE

Goods in stock are offered subject to prior sales or shipment.

SHIPMENT, DELIVERIES OR CANCELLATIONS

Shipment dates are estimated and Armstrong will not be liable for late shipments. Armstrong shall not be liable for any charges or damages arising directly or indirectly, out of loss, damage, stoppage or delay and interruption with respect to shipments or to delivery schedules resulting from fire, storm, flood, war, explosion, accident, strike, lockout, labour disturbance, embargos, riots, acts of civil or military authority, acts or omissions of the Customer or acts of God or public enemies, inability to obtain product from supplier, accident or breakdown to, or mechanical failure of, machinery and equipment, changes in economic conditions or other causes beyond Armstrong's reasonable control. If shipments are delayed or deferred by the Customer more than one month beyond the original shipping date, payment for goods shall become due at the time and storage or warehousing charges of the lesser of (i) 2% per month (24% per annum) or (ii) the highest rate permitted by law. No order for assembled to order equipment may be cancelled, materially altered or terminated except upon payment to Armstrong for loss, damage and expense arising from such cancellation, alteration or termination, including a reasonable profit and overhead. Armstrong reserves the right to discontinue the sale of certain of its products and to change the contents and packaging thereof. Armstrong shall not incur any liability thereby or any obligation to change or repurchase any such products sold to the Customer.

LIMITATION OF LIABILITY

Notwithstanding anything to the contrary herein contained, Armstrong shall not be liable to Customer or any third party for any consequential, contingent, incidental, liquidated, indirect or special damages, lost profits or other losses of customer or any third party arising, directly or indirectly, in respect of any products or services provided by Armstrong to the Customer or the sale, transportation, use or failure thereof, whether based on breach of warranty, negligence or otherwise. Without limiting the generality of the foregoing, the parties acknowledge and agree that: (a) Armstrong shall not be liable for any damages which result from the Customer's failure to take reasonable steps to maintain and inspect the products provided by Armstrong and their related components or failure to have appropriate standby procedures in place in relation thereto, (b) Armstrong shall not be liable for any damages arising, directly or indirectly, in respect of any components provided to the Customer by Armstrong which were purchased by Armstrong from other manufacturers or the use or failure thereof and (c) Armstrong's maximum liability to the customer shall be limited to the replacement value of any products provided by Armstrong to the Customer.

STATUTE OF LIMITATIONS

Any action of any nature by Customer against Armstrong must be commenced by Customer within one year after the cause of action first accrued.

DEFAULT

If Customer (a) fails to pay any amount due to Armstrong when due, (b) fails to observe or perform any of its other obligations under these terms and conditions, (c) takes any action that in Armstrong's opinion adversely affects the name, reputation or goodwill of Armstrong or its products, (d) is an entity and the person(s) that controls Customer on the date these terms and conditions are issued to Customer no longer controls Customer or (e) becomes insolvent, is adjudicated a bankrupt, voluntarily files or permits the filing of a petition in bankruptcy, makes an assignment for the benefit of creditors, seeks any similar relief under any bankruptcy laws or related statutes or a receiver is appointed for its assets, then, at Armstrong's sole option, all sums due or to become due from Customer to Armstrong may become immediately due and payable, and concurrently, or in the alternative, Armstrong may terminate any existing order between the Parties in whole or in part, defer shipment or delivery of any products, sell any part of any undelivered products and exercise any other remedies available to Armstrong under applicable law.

COSTS AND EXPENSES; INDEMNIFICATION

Customer will be responsible for all costs and expenses, including attorneys' fees and disbursements, incurred by Armstrong in enforcing any term or condition herein and Customer will indemnify and promptly reimburse Armstrong for such costs and expenses. Customer agrees to indemnify and hold the Armstrong and its officers, directors, employees, agents, affiliates and customers harmless from all costs, expenses and losses incurred by any of them which relate to or arise out of Customer's or Customer's customers use, transportation, handling, installation, sale, distribution or disposal of any products sold hereunder or Customer's failure to perform any obligation hereunder.

[CONFIDENTIAL INFORMATION

Armstrong's technical, trade secret, proprietary or similar information (collectively, "Confidential Information") disclosed by Armstrong to Customer or its officers, directors, employees or agents (collectively, "Representatives") and all copies thereof are the sole and exclusive property of Armstrong. Such disclosure will not be construed as granting to Customer or its Representatives any right, title or interest of any kind in any Confidential Information. Upon Armstrong's request, Customer will promptly deliver to Armstrong all Confidential Information in Customer's possession which is in written or electronically-readable form, including all copies or extracts thereof or based thereon in its possession or in the possession of any of its Representatives. All Confidential Information will be kept confidential by Customer and will not be disclosed to any person or entity without Armstrong prior written consent. Customer will be responsible for any breach of this covenant by Customer or any of Customer's Representatives and will indemnify Armstrong and its officers, directors, employees, agents, affiliates and customers for any costs, expenses or losses incurred or suffered by any of them as a result of such breach.]

TERRITORIAL RESTRICTIONS

The Customer shall not without the express written approval of Armstrong (which shall not be unreasonably withheld) export or use any products provided by Armstrong, or sell or hire such products to a person or entity who to its knowledge intends to export or use it, outside the country of intended use as declared to Armstrong. The Customer undertakes to comply with export control restrictions where applicable. If export or import restrictions are imposed or export or import licenses are cancelled, withdrawn or not renewed, then the Customer shall pay for all goods already delivered at the contract rate and payments already made may be used by Armstrong in respect of claims or demands made or losses incurred hereunder.

SECURITY INTEREST

Customer hereby grants to Armstrong a priority lien and security interest in products sold to Customer and in all proceeds of such products to secure Customer's obligations to Armstrong hereunder. Customer appoints each officer of Armstrong as an attorney-in-fact for Customer for the purpose of executing and filing each financing statement or other documents necessary to perfect such security interest. Upon the failure of Customer to pay the purchase price for any products when due, or to perform any of Customer's obligations under these terms and conditions, Armstrong will (a) without any judicial process, have the right to enter upon Customer's premises and take possession of any such products or to receive such products from Customer upon Armstrong's demand and (b) have all other rights and remedies of a secured party under the Uniform Commercial Code of the [State of New York] and any other applicable law.

GOVERNING LAW; JURISDICTION; VENUE:

Armstrong's offer, sales contract, invoice, these terms and conditions, Armstrong's order acknowledgment and any other document delivered by Armstrong to Customer will be governed by and construed according to the laws of the [State of New York], without reference to the principles of conflicts of law. Armstrong and Customer each hereby irrevocably and unconditionally (a) consents to submit to the exclusive jurisdiction of the United States District Court for the [Western District of New York] or the applicable state court located in the State of New York, [County of Erie] for any action or proceeding arising out of or relating to the

sale of Armstrong's products to Customer, (b) waives any objection to the laying of venue of any such action or proceeding in such courts and (c) waives and agrees not to plead or claim in any such court that any such action or proceeding brought in any such court has been brought in an inconvenient forum.

MISCELLANEOUS

It is understood that neither party hereto is constituted as an agent, employee or servant of the other party for any purpose whatsoever. The Customer shall be solely responsible for its acts, conduct and expenses and the acts, conduct and expenses of its employees and agents. These terms and conditions will be binding upon the Parties and their respective successors and assigns; provided, however, that Customer may not assign any of its rights or duties hereunder without Armstrong's prior written consent. If any of the provisions of these terms and conditions are held by a court or other tribunal of competent jurisdiction to be unenforceable, the remaining provisions of these terms and conditions will remain in full force and effect. Armstrong's offer, sales contract or invoice, these terms and conditions and Armstrong's order acknowledgement constitute the entire agreement between Armstrong and the Customer with respect to the sale of Armstrong's products to Customer, superseding all prior representations, agreements or understandings, written or oral, between the parties with respect to such sale. These terms and conditions cannot be amended orally or by any course of conduct by either party, but may only be amended by a written agreement executed by the Parties. The failure by Armstrong to (a) enforce any provision hereof will not be construed as a waiver of such provision or of Armstrong's right to enforce such provision and (b) object to provisions contained in any purchase order or other communication from Customer will not be construed as a waiver of these terms and conditions nor an acceptance of any such Customer provisions.

ACCEPTANCE

The Customer's acceptance of any goods supplied by Armstrong or on Armstrong's behalf shall without limitation constitute acceptance of all terms and conditions as stated herein.

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