

# AUTOMATIC LIQUID FLOW REGULATOR

## Type AFR-3

FOR MECHANICAL PUMPED (AMMONIA) LIQUID  
OVERFEED SYSTEMS

### FEATURES

- External Adjustment
- Easy Setting Scale
- Eliminates System Balancing
- Integral Check Valve
- "Frost Free" Neck
- Design Pressure (MRP): 27.6 bar (400 psig)

### DESCRIPTION

This precision built, heavy duty, self-contained, iron bodied Automatic Flow Regulator, is used as a liquid control device for Ammonia Overfeed Systems. This Automatic Flow Regulator, once set, maintains a constant flow rate of liquid to the evaporator; it also serves as a check valve to prevent back flow into the liquid line from the evaporator during pressure reversals such as occur during hot gas defrost.

### APPLICATION NOTE

An AFR flow regulator is designed to maintain an approximately constant liquid refrigerant delivery rate into the evaporator. However, it is not an expansion device capable of controlling vapor or two phase flow. Design conditions which allow for the formation of flash gas as liquid flows through the regulator can cause the AFR to chatter and result in irregular liquid delivery. This feed device should be applied only where sufficient liquid subcooling exists to ensure that its outlet pressure will never be reduced to less than the liquid's saturation vapor pressure. AFR's are not recommended for application in gas displacement systems or where controlled pressure receivers deliver liquid to the evaporators.

### SELECTION INFORMATION

This single AFR-3 Regulator can be adjusted to maintain a constant flow rate from 0.3 gpm to 3.6 gpm of liquid ammonia at pressure drops from 5 psi to 60 psi. This is equivalent to a refrigeration effect range from 5.0 tons to 60 tons at a recirculation rate of 1:1 (no overfeed) or 1.7 tons to 20 tons at a recirculation rate of 3:1 (200% overfeed). To set the regulator, multiply the evaporator load in tons by the desired recirculation rate and set the indicator scale to the resulting load. For example: 10 ton (evaporator load) x 3 (recirc. rate) = 30 (scale setting). For metric system usage, convert KW to tons and repeat as above.

Two or more AFR-3 Regulators may be installed in parallel to obtain capacities greater than that available from one regulator. The total capacity delivered will be equal to the sum of the settings on each regulator.

## BULLETIN 41-10D Type AFR-3



February 2003  
Installation, Service and Parts Information

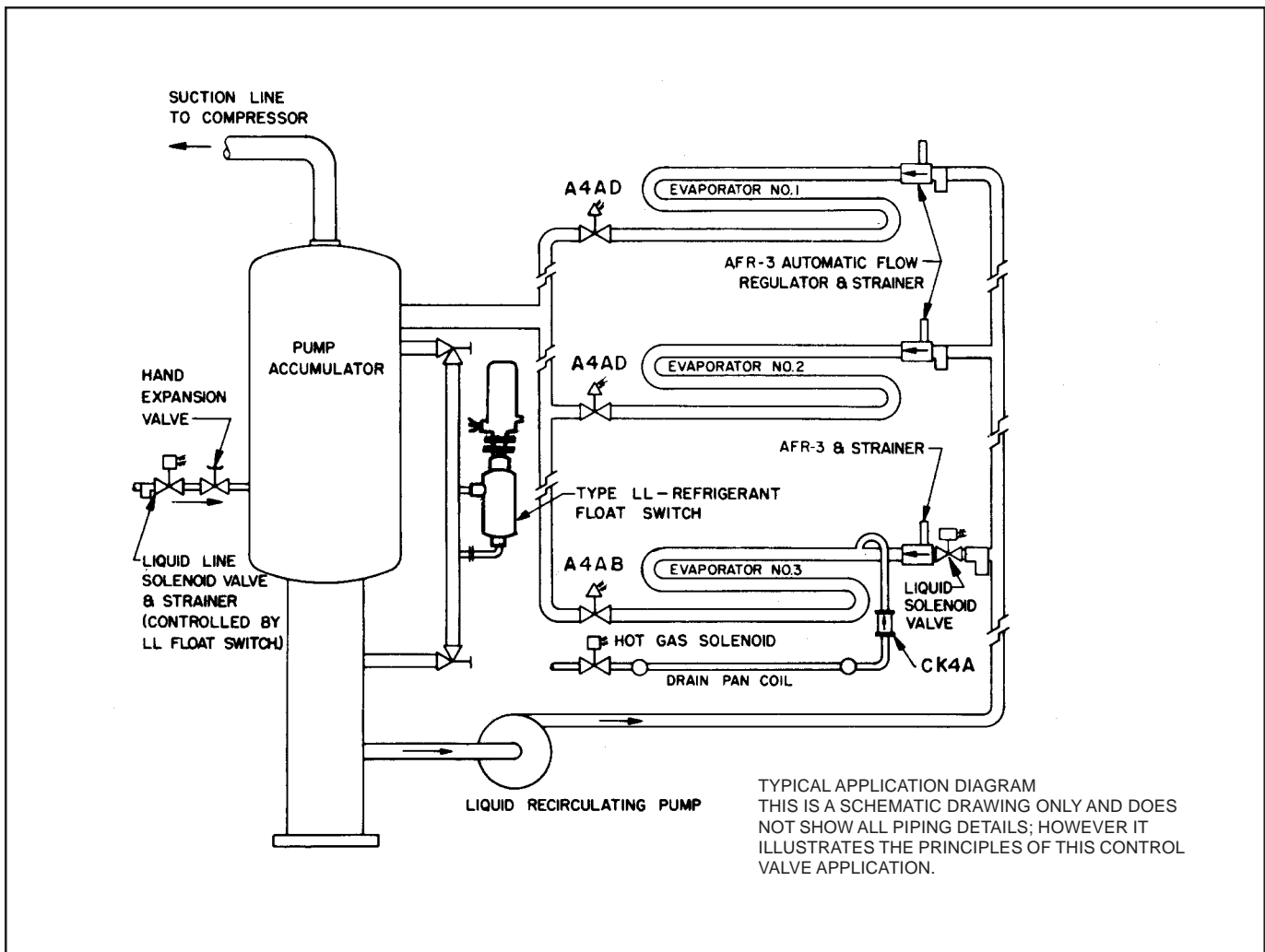
### PRINCIPLES OF OPERATION

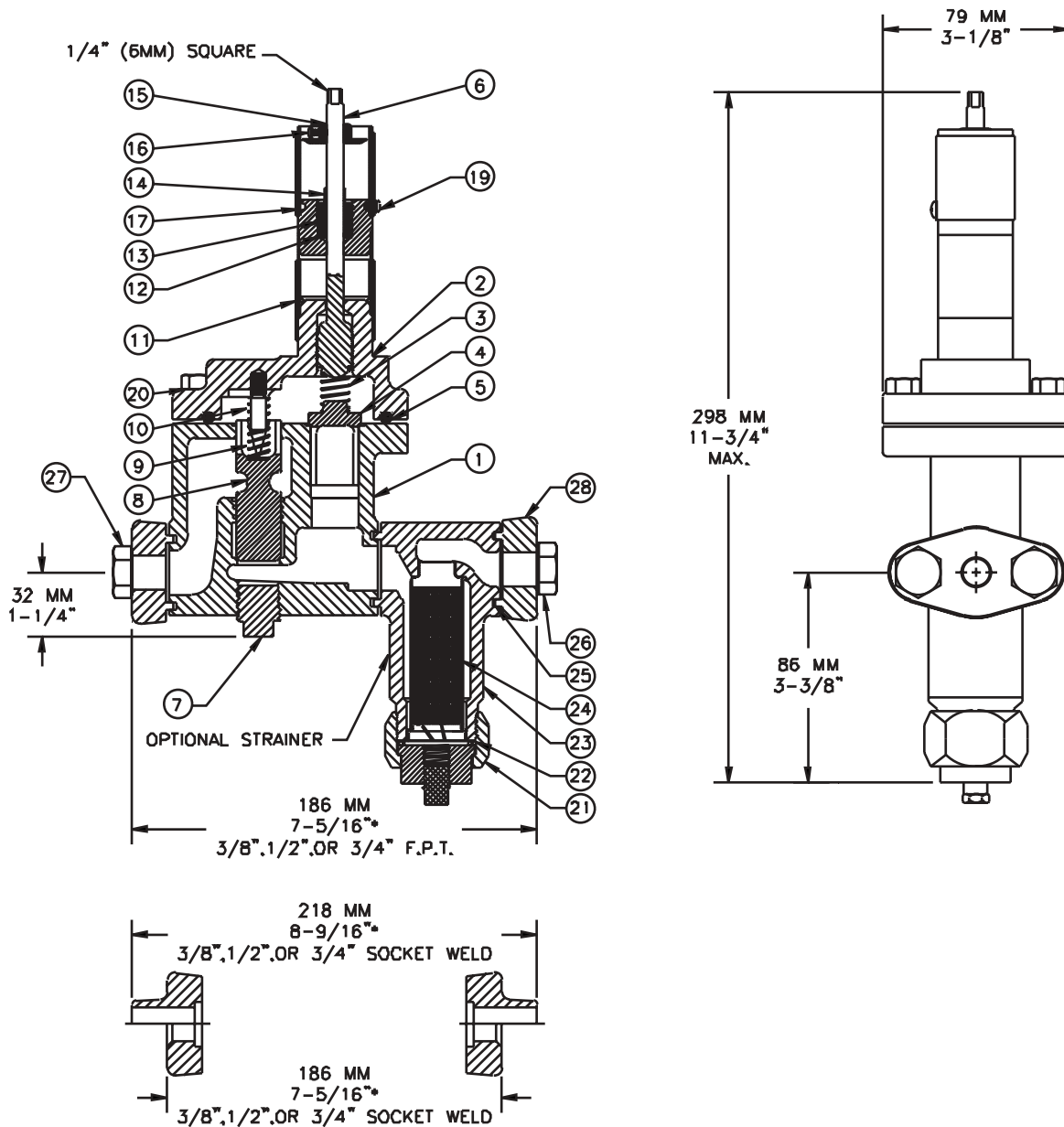
This is a constant flow automatic regulator. Once the flow rate is set by the Adjusting Stem #6, this flow will remain practically constant despite fluctuations in liquid line (inlet) or evaporator (outlet) pressures.

Starting with no flow, when the evaporator is shut off by a hand valve or solenoid valve, Metering Plug #4 is closed against its seat by Spring #3 and Regulating Plug #8 is opened wide by Spring #9. When the flow is started, the incoming refrigerant pressure raises Metering Plug #4 until it is stopped by the Adjusting Stem #6. As the flow increases the pressure drop across the Metering Plug Opening #4 increases, which creates a larger pressure difference across the piston portion of Regulating Plug #8 from port "N" to port "P". The Regulating Plug is moved upward, which causes a reduction in the Regulating Plug Opening. This opening size is automatically varied to balance the Spring #9 force on top of the Regulating Plug, which results in a constant pressure drop from port "N" to space "R". Once the Adjusting Stem #6 is set, the Metering Plug #4 has both a constant opening (flow area) and a constant pressure drop, thereby keeping a constant flow of liquid to the evaporator.

When a change in flow is desired, turning the #6 Adjusting Stem to reach a new Indicator setting changes the position of the back stop for the Metering Plug #4. This causes a change in the Metering Plug opening. Since the Regulating Plug #8 still maintains a constant pressure drop across the Metering Plug #4, a new constant flow rate is established. If a pressure reversal should occur in the system, such as during a hot gas defrost operation, the Regulating Plug will backseat at "B" and the Metering Plug will close on its seat at "A", thereby stopping any reverse flow. This feature of the AFR Regulator eliminates the need for a liquid line check valve.

PARTS LIST					
Item	Description	Kit	Item	Description	Kit
1	Valve Body		14	Stuff ing Box Nut	
2	Cover & Adapter Assembly		15	Indicating Disc	
2,5,9,10,12,13	Cover Kit	201177	16	Set Screw	
3	Metering Plug Spring		17	Tube (Upper)	
4	Metering Plug		18	Indicator Scale	
5/5a	Gasket / O-Ring		19	Set Screw (Upper Tube)	
3,4,5, 5a	Plug Kit, Metering	201181	20	Cap Screw	
6	Adjusting Stem Assembly		21	Strainer Cap	
6,12,13	Stem Kit, Adjusting	201179	22	Gasket	303070
7	Pipe Plug		23	Strainer Body	
8	Regulating Plug		24	Screen Assembly	
9,8,5,5a	Plug Kit, Regulating	201183	21,22,24	Screen Kit	200136
9	Regulating Plug Spring		25	Gasket, Flange (12)	202078
10	Spring Guide Pin		26	Bolt	
11	Name Tag		27	Nut	
12	Stuffing Box Washer		28	Flange, FPT	
13	Packing Ring		29	Flange, Socket Weld	
14	Stuffing Box Nut		30	Flange, Weld Neck	





\* FOR VALVE WITHOUT STRAINER DEDUCT 2IN, (51 MM)

NET WEIGHT		
Valve with C,F,B, & G	Strainer with B & G	Valve and Strainer
9 lbs	2 lbs	11 lbs.
4.1 Kilo	0.9 Kilo	5.0 Kilo
Bolt Diameter	Valve Size	Torque
5/16" (8mm)	13-21	11 ft lb (1.5 mkg)

**If a liquid solenoid valve or a hand valve is used to shut off the evaporator fed by the AFR, it must be placed upstream of the AFR Regulator.** A positive shut-off valve closed downstream of the AFR Regulator might trap solid liquid between the valves because of the check valve characteristic of the AFR. If the temperature of this trapped liquid were to increase, high pressures could be caused by the expanding liquid and could possibly rupture a gasket, valve or pipe. **Service valves placed downstream of the AFR should be tagged, warning against accidental closing.** This excessive hydrostatic pressure possibility exist whenever a portion of the cold liquid line can be closed off from the rest of the system by hand valves, check valves or automatic valves. It is no more a characteristic of the AFR than it is of any valve in a cold liquid line. Solenoid valves, hand valves, or strainers placed upstream of the AFR Regulator should be properly sized to allow for a low pressure drop that will not cause flashing because the AFR Regulator should have 100% liquid ammonia at the inlet with no flash gas present in order to give good flow control.

## INSTALLATION

Protect the inside of the regulator from dirt and chips during installation. Normally, the regulator should be mounted on a horizontal liquid line with the adjusting stem at the top. Allow 3" space above regulator for removal of the #6 Adjusting Stem and the #2 Cover and Adapter Assembly. Allow 1-1/2" space below the regulator for removal of #7 Cleanout Plug. The regulator must be installed with the arrow on the regulator pointing in the direction of controlled fluid flow through the regulator. If installed backwards, all fluid flow will be stopped because the AFR Regulator will allow flow in one direction only. It is advisable to install the companion strainer ahead of the AFR Regulator for protection against dirt and chips. This AFR Regulator and its close-coupled strainer are easily removable for cleaning or repairing without disturbing threaded or welded joints. To remove this regulator, merely unscrew the flange bolts and spread the flanges slightly apart.

## ADJUSTMENT

The flow rate is adjusted with a wrench by means of the Adjusting Stem #6 which extends above the top of the valve. The thin line at the bottom edge of Indicating Disc #15 is opposite a number on the Indicator Scale #18 which represents the Tons of Refrigeration capacity available if a 1:1 recirculation rate were being used. The desired recirculation rate is determined by the overall system design. This rate multiplied by the individual refrigeration load requirement to be handled by this AFR provides the number on the Indicator Scale #18 at which the valve should be set. For example: 10 ton capacity required x 3 recirc. rate = Set Indicator Scale Line opposite 30.

## SERVICE POINTERS

1. The AFR Regulator can be disassembled and serviced by removing the 6 - #20 Cap Screws and lifting off the cover and Adapter Assembly #2. Springs #3 and # 10 are retained in the Cover and Adapter Assembly #2. Good regulator performance is dependent upon smooth motion of the Metering Plug #4 and particularly the Regulating Plug #8. Be sure that plug surfaces and cylinder bores are smooth and clean before re-assembling. Apply a light film of refrigerant oil on moving parts, making sure that both plugs move freely during assembly. The disassembly and reassembly should not change the calibration of the regulator. Pipe Plug #7 can be removed to clean out dirt trapped in the bottom of the regulator.

2. Too Much Flow: **(a)** Adjusting Stem #6 is set at too high a number on the indicator scale. Readjust lower. **(b)** Dirt or chips in regulator is causing either Metering Plug #4 or Regulating Plug #8 to stick. Disassemble and thoroughly clean regulator. Follow assembly instruction in paragraph #1 above.

3. Too Little Flow: **(a)** Adjusting Stem #6 is set at too low a number. Readjust higher. **(b)** Dirt has fouled regulator. See 2(b) above. **(c)** Strainer Screen #24 is plugged. Remove Strainer Cap #21, remove screen, clean and replace. **(d)** Regulator is not receiving 100% liquid ammonia. Regulator must pass liquid with no flash gas present or its capacity and longevity will be reduced. Examine the line ahead of regulator for restrictions that may cause excessive pressure drop. If solenoid valve or hand valve are used ahead of AFR Regulator, be sure these are fully open to liquid flow and that strainers are not plugged with dirt or oil. Upstream liquid line conditions and pipe and valve sizing should be selected to furnish liquid with at least 8°F subcooling at inlet of AFR Regulator.

4. Erratic Flow: **(a)** Dirt has fouled regulator. See 2(b) above. **(b)** Regulating Plug #8 has become worn or eroded. Replace with new plug. Follow assembly instructions in paragraph #1 above.

5. Regulator fails to close against reverse flow: **(a)** Dirt or chips in regulator is causing either plug to stick. Follow instructions in paragraph #1 above. **(b)** Seat on either plug may be eroded enough to cause leakage. Eroded parts must be replaced. Follow instructions in paragraph #1 above.

## SAFE OPERATION (See Bulletin RSBCV)

People doing any work on a refrigeration system must be qualified and completely familiar with the system and the valves involved, or all other precautions will be meaningless. This includes reading and understanding pertinent product bulletins and the current Bulletin RSB prior to installation or servicing work.

## WARRANTY

All Refrigerating Specialties Products are warranted against defect in workmanship and materials for a period of one year from date of shipment from the factory. This warranty is in force only when products are properly installed, maintained and operated in use and service as specifically stated in Refrigerating Specialties Catalogs or Bulletins for normal refrigeration applications, unless otherwise approved in writing by Refrigerating Specialties Division. Defective products or parts thereof, returned to the factory with transportation charges prepaid and found to be defective by factory inspection will be replaced or repaired at Refrigerating Specialties' option, free of charge, F.O.B. factory. Warranty does not cover products which have been altered or repaired in the field; damaged in transit, or have suffered accidents, misuse, or abuse. Products disabled by dirt, or other foreign substances will not be considered defective.

THE EXPRESS WARRANTY SET FORTH ABOVE CONSTITUTES THE ONLY WARRANTY APPLICABLE TO REFRIGERATING SPECIALTIES PRODUCTS, AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING ANY WARRANTY OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE. No employee, agent, dealer or other person is authorized to give any warranties on behalf of Refrigerating Specialties, nor to assume, for Refrigerating Specialties, any other liability in connection with any of its products.