

6700 Liquid Level Indicator

Accurate gaugeboard indicator for level measurement



Copyright

2018, All rights reserved. Printed in the United States of America.

Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, mechanical, photocopying, recording, or otherwise – without the prior written permission of the Publisher:

Varec, Inc.
5834 Peachtree Corners East
Peachtree Corners (Atlanta), Georgia 30092
Phone: (770) 447-9202
Fax: (770) 662-8939

Trademarks Acknowledged

Varec, Inc. recognizes all other trademarks. Trademarks of other products mentioned in this manual are held by the companies producing them.

FuelsManager®, TankView®, TacFuels®, Varec®, 8130 RTU8130®, and FuelsManager IntoPlane® are registered trademarks of Varec, Inc.

HART® is a registered trademark of HART Communication Foundation, Austin, USA

ToF® is a registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

FieldCare® is a registered trademark of the company Endress+Hauser Flowtec AG, Rheinach, CH

All other product and service names mentioned are the trademarks of their respective companies.

Disclaimer of Warranties

The contract between the Seller and the Buyer states the entire obligation of the Seller. The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment, or relationship between the Seller and Buyer. There are no express or implied warranties set out in this instruction manual. The only warranties that apply are those in the existing contract between the Seller and Buyer.

The 6700 Liquid Level Indicator (LLI) has not been tested by Varec under all possible operational conditions, and Varec may not have all the data relative to your application. The information in this instruction manual is not all inclusive and does not and cannot take into account all unique situations. Consequently, the user should review this product literature in view of his or her application. If you have any further questions, please contact Varec for assistance.

Limitations of Seller's Liability

In the event that a court holds that this instruction manual created some new warranties, Seller's liability shall be limited to repair or replacement under the standard warranty clause. In no case shall the Seller's liability exceed that stated as Limitations of Remedy in the contract between the Seller and Buyer.

Use of parts that are not manufactured or supplied by Varec voids any warranty and relieves Varec of any obligation to service the product under warranty. Varec recommends the use of only Varec manufactured or supplied parts to maintain or service Varec 6700 Liquid Level Indicator.

Terms of Use

The information provided in this document is provided "as is" without warranty of any kind. Varec, Inc. disclaim all warranties, either express or implied, including the warranties of merchantability and fitness for a particular purpose. In no event shall Varec, Inc. or its suppliers be liable for any damages whatsoever including direct, indirect, incidental, consequential, loss of business profits or special damages, even if Varec, Inc. or its suppliers have been advised of the possibility of such damages.

This manual is solely intended to describe product installation and functions and should not be used for any other purpose. It is subject to change without prior notice. This manual was prepared with the highest degree of care. However, should you find any errors or have any questions, contact one of our service offices or your local sales agent.

Safety Precaution Definitions

Caution! Damage to equipment may result if this precaution is disregarded.

Warning! Direct injury to personnel or damage to equipment which can cause injury to personnel may result if this precaution is not followed.

Safety Precautions

Read this manual carefully and make sure you understand its contents before using this product. Follow all instructions and safety guidelines presented in this manual when using this product. If the user does not follow these instructions properly, Varec cannot guarantee the safety of the system.

Note Comply with all applicable regulations, codes, and standards. For safety precautions, the user should refer to the appropriate industry or military standards.

Caution! Electrical Hazard! Read and understand static and lightning electrical protection and grounding described in API 2003. Make certain that the tank installation, operation, and maintenance conforms with the practice set forth therein.

Warning! Make certain that the tank is empty and not in service. Ensure that the tank has been leak and pressure tested as appropriate for the liquid to be stored. Observe appropriate safety precautions in flammable or hazardous liquid storage areas. Do not enter a tank that has contained hydrocarbons, vapors, or toxic materials until a gas free environment is certified. Carry breathing equipment when entering a tank where oxygen may be displaced by carbon dioxide, nitrogen, or other gases. Wear safety glasses as appropriate. Use a hard hat.

Warning! Under most circumstances, the mechanical connections between the guide cables and the anchors provide a resistance to ground that is adequate for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product. Additional grounding may be needed for products with low flash points. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard. Observe American Petroleum Institute (API) Recommended Practice 2003 or other appropriate industry or military standard.

ATEX Exemption

The 6700 Liquid Level Indicator (LLI) is considered a simple apparatus. It moves very slowly, and has a low capacity to store energy. It is incapable of forming hot surfaces or other ignition sources, even in cases of rare malfunction. Simple apparatus are not to be classified as ATEX equipment or to be marked according to ATEX Directive 2014/34/EU.

For use in gas groups IIA, IIB, and IIC.

Installation Location	Wetted Parts (float, cable, bottom anchor, top anchors, sheave elbows)	Non-Wetted Parts (gaugeboard, level indicator)
Hazardous locations - Zone 0	Yes	No
Hazardous locations - Zone 1	Yes	Yes
Hazardous locations - Zone 2	Yes	Yes
Normal (nonhazardous) locations	Yes	Yes

Contents

1	Introduction	1
	Getting Started	1
	Accessories	2
	Float Ground Kit	8
2	Installation	9
	Oil Seal Installations	11
	Installation of Oil Seal, 8.5-Inch Water Column Operating Pressure Model	12
	Installation of Oil Seal, 27-Inch Water Column Operating Pressure	13
	Cone Roof Tank Installation	13
	Connecting the Tape to the Float	21
	Initial Calibration	22
	Initial Lubrication	23
	Reassembly	24
	Cone Roof Tank (Bolted Installation)	24
	Connecting the Tape to the Float	27
	Initial Calibration	28
	Initial Lubrication	29
	Reassembly	30
	Cone Roof Tank Installation (Fiberglass Tank)	32
	Connecting the Tape to the Float	34
	Initial Calibration	35
	Initial Lubrication	36
	Reassembly	37
	In-service Tank Installations	39
	General Preparation	40
	Independent Pipe Support Structure	40
	Installation of Model 228 Inspection Hatch to Existing Manhole Cover	41
	Anchor Bar Installation	41
	Float Installation	44
	Initial Lubrication	46
	Reassembly	47
	Installation of Model 226 for 20 and 24 Inch Manhole Covers with API Drilling	47
	Typical Auxiliary Equipment Installation	47
3	Operation	49
	Initial Operation	49
	Normal Operation	49
	Calibration and Volume Measurement	49
4	Maintenance	51
	Periodic Maintenance	51
	Electrostatic Discharge Hazard	51
	Lubrication	51
	Oil Recommendations for Oil Seal Accessory Units	52

Inspection	52
Troubleshooting Common Problems	52
5 Specifications	55
Liquid Level Indicator	55
Standard Installation Kits	55
Standard Float Specifications	55
Bottom Anchor Bar Weight	56
Other Specifications	56
Reference Part Numbers	56
Indicator Part Numbers	57
Float Part Numbers	58
Sheave Elbow Part Numbers	59
Bottom Anchor Bar Weight Part Number	60
Oil Seal Accessory Part Numbers	61
6 Order Codes	63
Order Code Table	63

Introduction

This manual is designed to assist the user with the installation, configuration, operation, maintenance, and troubleshooting of the Varec 6700 Low Pressure Liquid Level Indicator.

Getting Started

The Varec 6700 Low Pressure Liquid Level Indicators are for use at atmospheric pressure.

If oil-seal units are installed, pressure of 1.0 psig is the maximum used with the 27-inch W.C. seal.

A system consists of the gaugeboard, sliding indicator, float, cables, elbows, and the user furnished gauge piping which carries the indicator cable.

Proper operation of the indicator requires the careful attention of the user to assure high quality control during installation. Long term, satisfactory performance of the sight gauge can thus be obtained. If the installation quality is compromised, sight gauge accuracy and life may be degraded.

Changes in the liquid level in the tank raise or lower the float, which moves the indicator cable. Cable movement drives the indicator up and down the gaugeboard on the side of the tank.

The liquid level in feet and inches, or meters, decimeters, and two-centimeter increments is indicated by the indicator position on the gaugeboard. The user may then convert the liquid level to units of volume. This may be accomplished manually, or Varec's computer aided data acquisition system may perform the task.

When the indicator is at the top of the gaugeboard, the tank is empty with the float at the bottom of the tank.

Chapter 2, Installation, covers installations to be performed on tanks that are empty and are not in service. The section, In Service Tank Installations, covers the additional procedures that are required for making installations on tanks that are in service.

Varec service contracts provide the user substantial savings for maintaining and refurbishing the systems. Contact Field Service, a Varec representative or Product Marketing for further details.



Accessories

Varec manufactures accessories for transmitting and telemetering the information to a Varec Data Acquisition System. Limit switches may be attached to the Liquid Level Indicator system to provide signaling functions. Figure 1 through Figure 6 illustrate some of the accessories available.

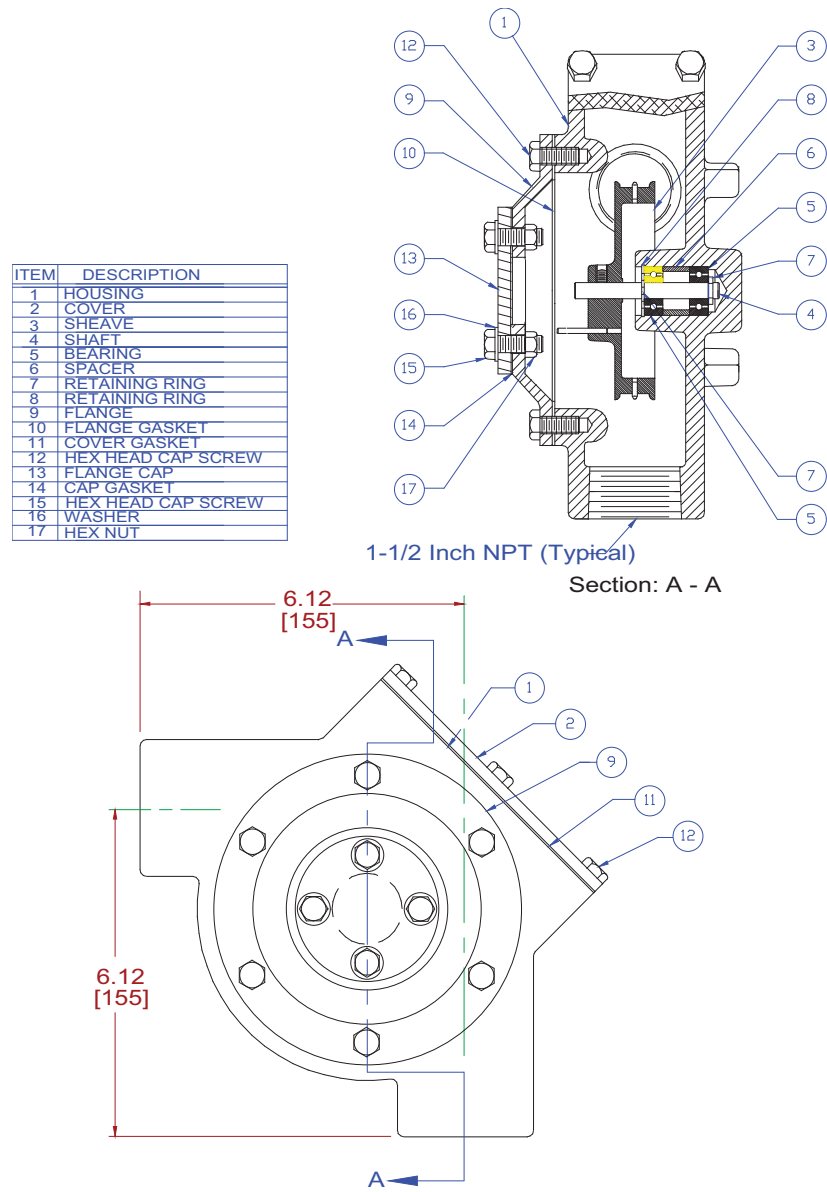


Figure 1: 6700 LLI Accessory Drive Elbow

Table 1: Part Numbers

Type	Part Number
English	BM4129
Metric	BM8564

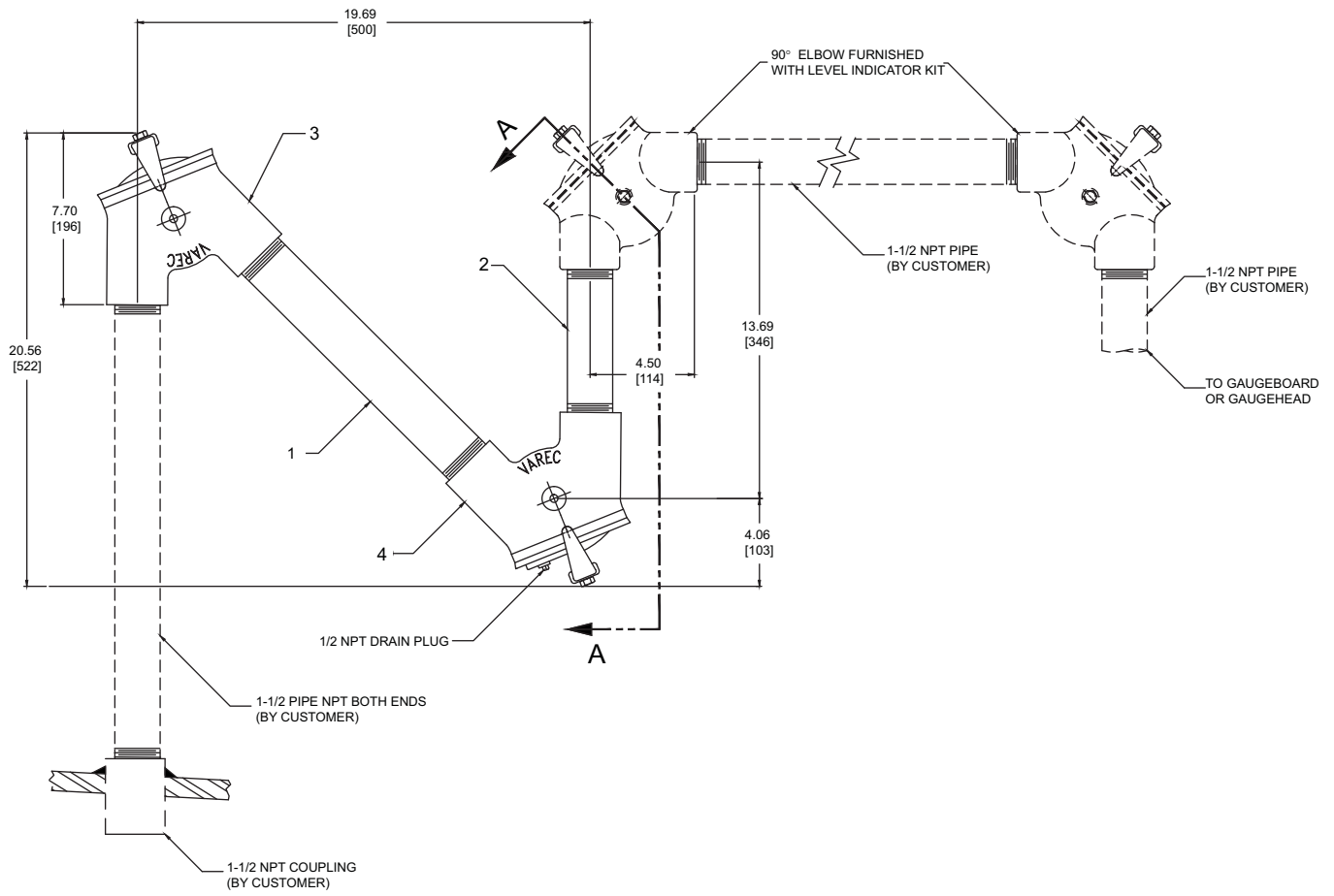


Figure 2: Oil Seal, 8.5-inch Water Column Operating Pressure Model

Table 2: Parts for Oil Seal, 8.5-inch Water Column

Item No.	Description
1	Pipe, 1-1/2" x 15.50 [394], NPT Ends (Long)
2	Pipe, 1-1/2" x 7.25 [184], NPT Ends (Short)
3	135° Sheave Elbow
4	135° Sheave Elbow with Drain

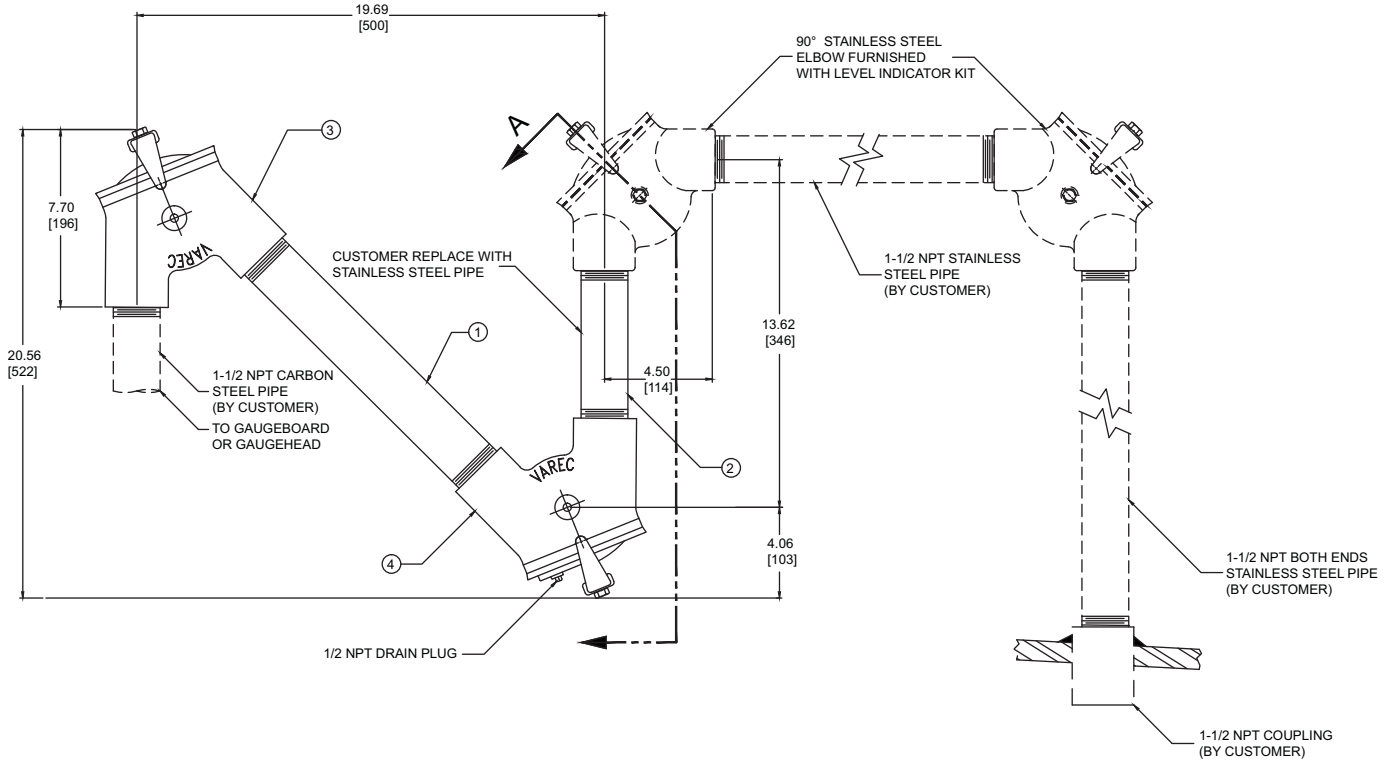


Figure 3: Oil Seal, Severe Service, 8.5-inch Water Column, Alternative Configuration

Table 3: Parts for Oil Seal, Severe Service, 8.5-inch Water Column

Item No.	Description
1	Pipe, 1-1/2" x 15.50 [394], Carbon steel, NPT ends (Long)
2	Pipe, 1-1/2" x 7.25 [184], NPT Ends (Short)
3	135° Aluminum Sheave Elbow
4	135° Aluminum Sheave Elbow with Elbow

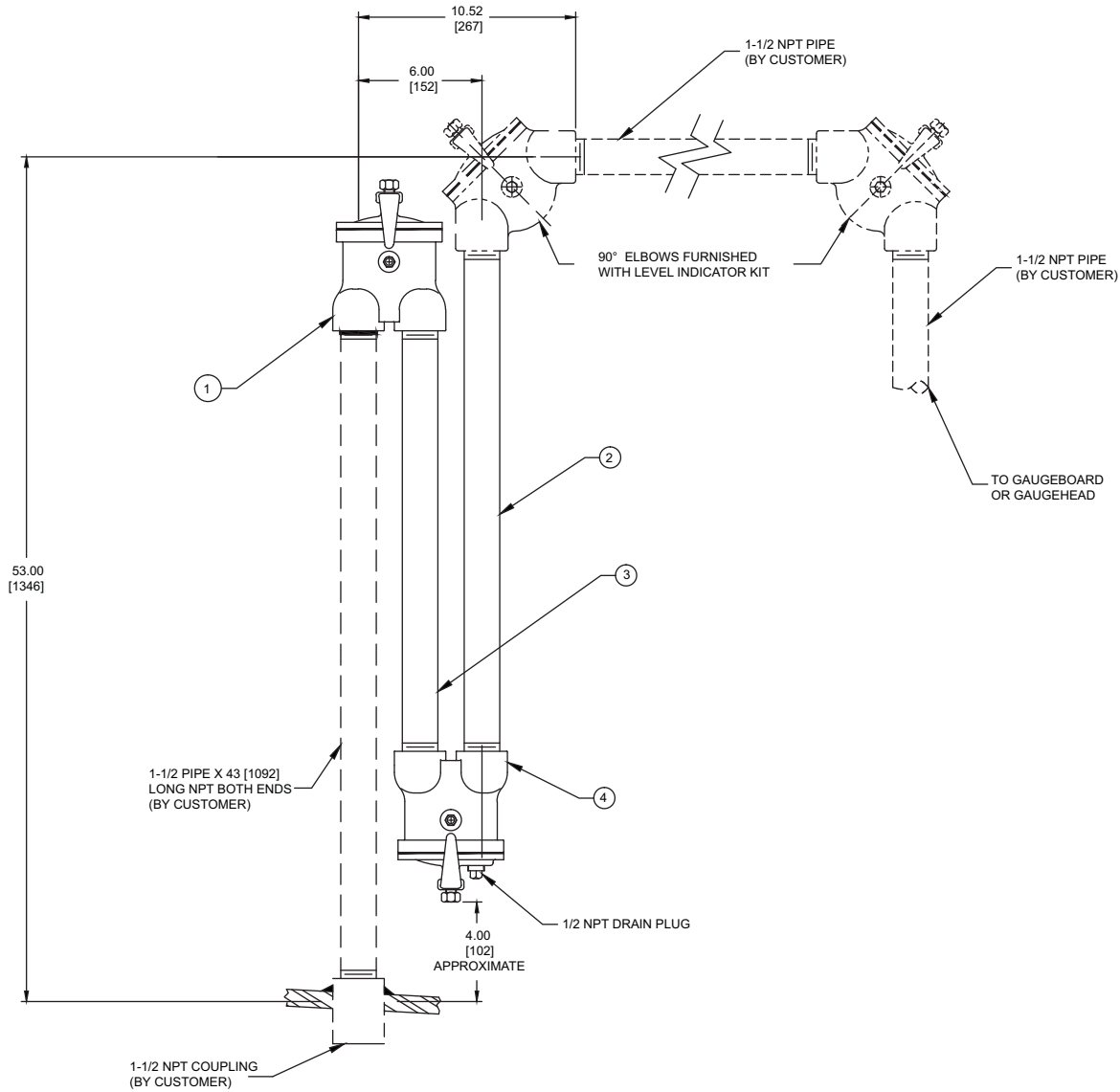


Figure 4: Oil Seal, 27-inch Water Column Operating Pressure Model

Table 4: Parts for Oil Seal, 27-inch Water Column

Item No.	Description
1	180° Elbow
2	Pipe, 1-1/2 x 38 [965], NPT Ends (Long)
3	Pipe, 1-1/2 x 32 [813], NPT Ends (Short)
4	180° Elbow with Drain

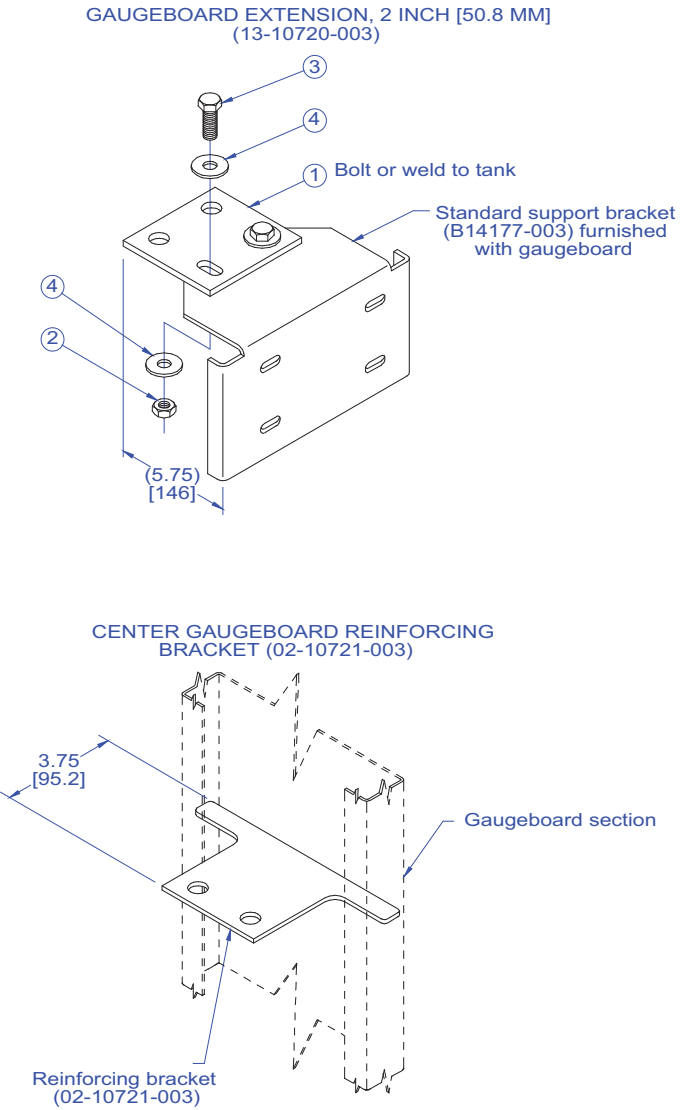


Figure 5: Options

Table 5: Gaugeboard Extension Parts

Item No.	Description
1	Extension Bracket
2	Hex Nut
3	Hex Head Cap Screw
4	Flat Washer

Float Ground Kit

The Float Grounding Kit positively grounds the float to the tape or cable. Connect the grounding cable (A) to the tape clamp (point B) and float (point C) as shown below.

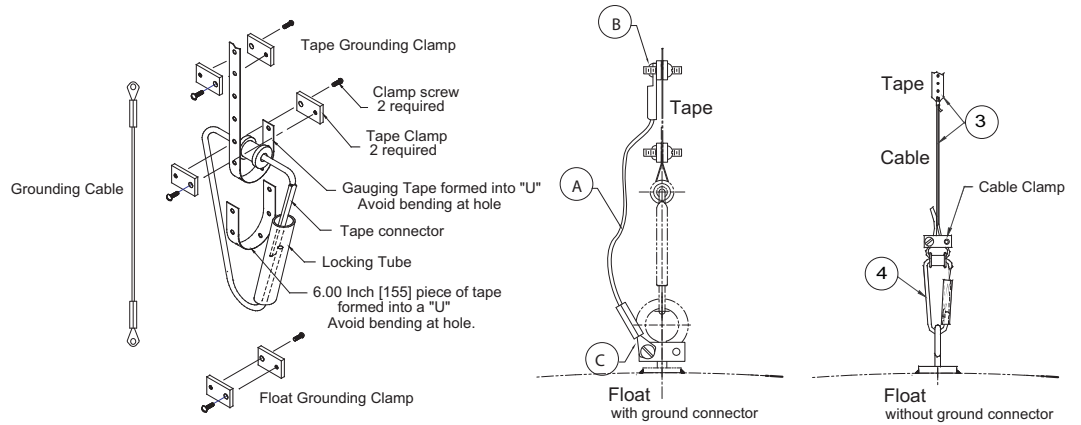


Figure 6: Float Grounding Kit Diagram

Installation

Refer to Chapter 1, Introduction to determine the feature and option codes of the unit to be installed. Use the Table of Contents to determine the appropriate installation figure in this Instruction Manual. These are typical installations. All situations may not be covered. Contact Varec if additional information is needed. It is paramount that the user monitor the quality of the installation to assure long term, accurate performance. If the quality is compromised, inferior operation may result.

Particularly important are:

- Accurate hand gauging referenced to the tank bench mark
- Clean interior of the gauge piping
- No kinks in the tape/cable
- No noticeable binding friction in the mechanism
- Installation cleanliness
- True vertical gauge piping
- Location of float away from inlet pipes of mixers

Warning Make certain that the tank is empty and not in service. Ensure that the tank has been leak and pressure tested as appropriate for the liquid to be stored. Observe appropriate safety precautions in flammable or hazardous liquid storage areas. Do not enter a tank that has contained hydrocarbons, vapours, or toxic materials until a gas free environment is certified. Carry breathing equipment when entering a tank where oxygen may be displaced by carbon dioxide, nitrogen, or other gases. Wear safety glasses as appropriate. Use a hard hat.

Warning Under most circumstances, the mechanical connections between the guide cables and the anchors provide a resistance to ground that is adequate for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product. Additional grounding may be needed for products with low flash points. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard. Observe American Petroleum Institute (API) Recommended Practice 2003 or other appropriate industry or military standard.

The user provides the 1.5-inch pipe that carries the tape/cable and the necessary mounting and support welding. The user must drill holes in the tank as needed. Assemble the necessary tools and equipment at the work site. Table 6 on page 10 lists typical tools and equipment that may be needed. Use a drop cloth to maintain tool, equipment, and installation kit cleanliness.

Plan the pipe routing. Locate the roof connection into the tank interior within arms reach of a manhole or an inspection hatch.

Table 6: Typical Tools, Equipment, and Materials List

Tool/Equipment	
Breathing equipment	Pick
Cable cutter	Pipe cutter
Chalk	Pipe taps/dies
Chalk line	Pliers
Clean drop cloth	Plumb bob
Compass	Protractor
Drill bits	Screwdrivers
Electric drill	Sheet metal shears
Hole cutters	Shovel
Level	String
Light oil	Tank hand gauge
Loctite 262	Vice
Loctite 567	Welding equipment
Long measuring tape	Wrenches

Note Install a Varec manhole or inspection hatch, if there is none located within arms reach of the tape pipe location. Refer to In-service Tank Installations later in this section for hatch and manhole installations.

Locate the float at a position inside of the tank where agitation on it will be at a minimum. Install a deflector if the product stream is close to the float. Contact Varec if agitators will cause excess float disturbances. Vertical pipe runs must be plumbed and perpendicular to prevent the tape from binding inside the pipe.

The user must attach the gaugeboard to the tank by welding or bolting the supplied gaugeboard support brackets. If the environment is such that welding cannot be performed, the user can construct a support structure with 3-inch [76 mm] pipe or conduit close to the outside of the tank. The brackets can be welded to the support structure at another location, if necessary, and the pipe structure assembled at the tank site. Refer to In Service Tank Installations later in this section for additional details.

Warning The user should comply with all applicable regulations, codes, and standards. For safety precautions, the user should refer to the appropriate industry or military standards.

Oil Seal Installations

Tank configuration instructions that follow do not include the use of the oil seal accessories (see Figure 2 on page 4 and Figure 4 on page 6). If these are to be installed, refer to these illustrations as appropriate and perform the following additional installation procedures.

Note Varec recommends an oil seal if the process temperature exceeds 200° F (93° C).

Installation of Oil Seal, 8.5-Inch Water Column Operating Pressure Model

Refer to Figure 2 on page 4.

1. Apply appropriate pipe thread compound and install long pipe (1) into 135-degree elbow with bottom drain (4).
2. Apply pipe thread compound and install short pipe (2) into 135-degree elbow with bottom drain (4).
3. Apply pipe thread compound and install 135-degree elbow (3) onto long pipe (1).
4. Apply pipe thread compound and install 90-degree elbow supplied with gauge kit onto short pipe (2).
5. Adjust the assembly to provide the tape/cable path illustrated in Figure 2-8 on page 29.
6. Provide 1.5-inch pipe installation, as required.
7. Proceed with the remainder of the tank installation to the paragraph Initial Lubrication, then fill the oil seal as follows:
 - a. See Chapter 4, Maintenance, for oil selection.
 - b. Remove the cover from 90-degree elbow.
 - c. Fill to halfway in the short pipe.

Note To drain the oil, open the plug in 135 degree elbow (4).

Installation of Oil Seal, 27-Inch Water Column Operating Pressure

Refer to Figure 4 on page 6.

1. Apply thread pipe compound and install short pipe (3) into 180-degree elbow (1).
2. Apply pipe thread compound and install 180-degree elbow (4) onto short pipe (3).
3. Apply pipe thread compound and install long pipe (2) into elbow (4).
4. Apply pipe thread compound and install 90-degree elbow supplied with gauge kit onto long pipe (2).
5. Complete the assembly to the user furnished 1.5-inch pipe.
6. Adjust the assembly to provide the tape/cable path as illustrated.
7. Proceed with the remainder of the tank installation to the paragraph Initial Lubrication, then fill the oil seal as follows:
 - a. See Chapter 4, Maintenance, for oil selection.
 - b. Remove the cover from 90-degree elbow.
 - c. Fill to halfway in the short pipe.

Note To drain the oil, open the plug in 180-degree elbow (4).

Cone Roof Tank Installation

Note Be sure to read General Preparation at the beginning of this section before proceeding with this installation.

Refer to Table 6 on page 10. See Figure 7 on page 16 for full travel or Figure 8 on page 17 half travel Liquid Level Indicators.

1. Determine the position on the tank roof, beneath which the center of the float will rise and fall. Notice that this position is located a minimum of 16 inches [406 mm] and a maximum of 36.00 inches [914 mm] from the wall of the tank.
2. Provide the roof holes shown in the figure, centered on this position. The float diameter is 14.50 inches [368 mm]. The guide cable holes are centered 8.50 inches [216 mm], each side of the center of the float. The indicator cable pipe is centered on a 17.00 inch [432 mm] diameter.
3. Check the angle of the roof.
4. Connect a pipe coupling to the 1.5-inch vertical pipe that is to be attached to the roof and hold it plumb while welding the coupling into the hole in the roof. Failure to place the coupling and pipe in a true vertical position may affect the accuracy of the Liquid Level Indicator. Make sure that the interior of all pipes are clean and corrosion free.
5. After the coupling and pipe are checked to make certain that they are plumb, unscrew the pipe from the coupling.
6. Seal the threads with pipe thread compound and reconnect the pipe to the coupling.

7. Center the base of a top cable anchor in its hole. Hold it plumb while welding it to the roof. Do the same for the other top cable anchor.
8. Remove the housing nipple and cap from the top cable anchors and hang plumb lines from them at the center to mark the position where the bottom cable anchor will be welded.
9. Mark the plumb bob string at the height of the tank bench mark. This will assure that the plumb bob just touches the bottom, when the reference is made from the bench mark distance to the bottom.
10. Hang a plumb line through the center of the top tape/cable pipe to the bottom to mark the float center. This should be 8.50 inches [216 mm] at the bottom from each of the bottom cable anchor positions.
11. When the positioning has been checked, weld the bottom cable anchor into place.
12. Thread the float guide cables into the tank through the top anchor fittings. Fasten them to the bottom cable anchor with the furnished hardware. Thread the upper end of each guide cable through the top anchor assembly. Hand tighten. Use the lock nut to lock the cable in place, then tighten the adjustment nut, until the guide cable is tensioned by the spring. Trim off excessive cable.
13. Replace the top anchor nipple and cap.
14. Apply appropriate pipe thread compound and install the sheave elbow on the vertical pipe to the tank interior. Install a pipe union in the horizontal pipe run, in order that the elbows can be easily removed, if necessary. Then install the horizontal pipe assembly into the tank drop elbow. Adjust the length as needed to properly position the outboard elbow.
15. Install the outboard elbow on the horizontal pipe.
16. Apply pipe thread compound and screw the gaugeboard connector pipe into the outboard elbow.
17. Remove the bolts, cover, and gasket from the outboard elbow and drop a plumb line through the center.
18. Drop a chalk line from the top of the tank parallel with the plumb line and mark the chalk line on the tank wall. See Figure 7 on page 16.
19. Use the width of the gaugeboard (7.44 inches [189 mm]) at the bottom of the tank wall and chalk register marks for the width as follows:

Full Travel Gaugeboard:
Board centered with chalked plumb line (see Figure 7 on page 16).

Half Travel Gaugeboard:
Board offset (1.03 inches [26.2 mm]) to the right of the chalked plumb line (see Figure 9 on page 18).
20. Do the same at the top of the tank.
21. Make chalk line marks between the top and bottom register mark to aid in keeping the gaugeboard sections centered and parallel during installation.
22. Weld the gaugeboard support brackets into position. See Figure 7 and notice the relative position of the top bracket. All other welds are seven feet below the previous weld, except for the last one at the bottom of the tank, which is six inches [152 mm] above the grade line.
23. Use the “U” bolt and nuts (see Figure 7) to attach the gaugeboard connector to the pipe. The pipe should extend one inch [25.4 mm] below the “U” bolt.

24. Attach the top section of the gaugeboard to the connector plate. Make certain that it is centered on the chalk line.
25. Attach the remainder of the sections to the bottom of the tank. Make certain that each section is centered on the chalk line (see Figure 7).

Note To fit the gaugeboard to the tank, cut the highest-numbered gaugeboard section at the marker that is 4.50 inches greater than the tank height to adjust the fit to the total height to the tank.

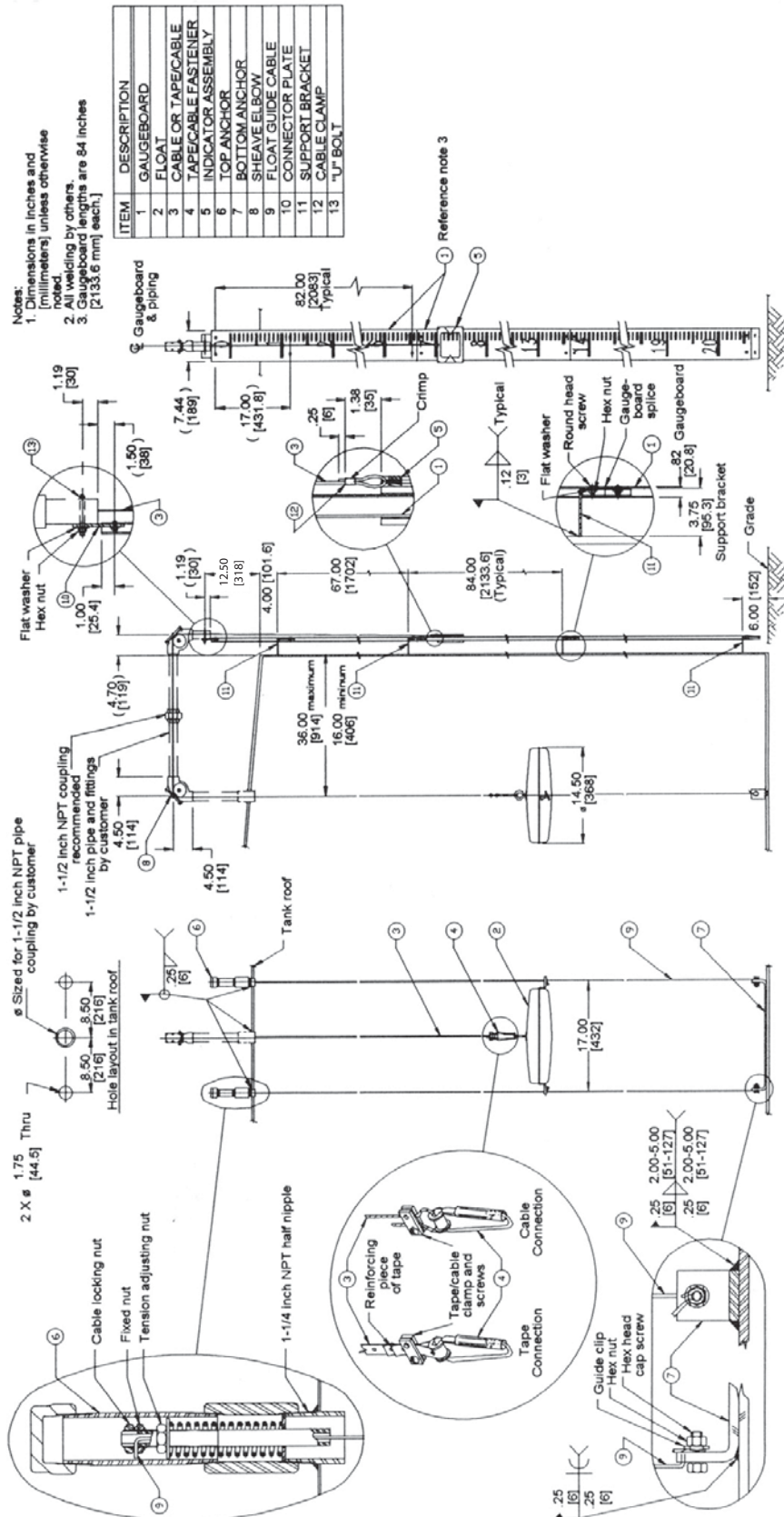


Figure 7: Cone Roof Tank Installation

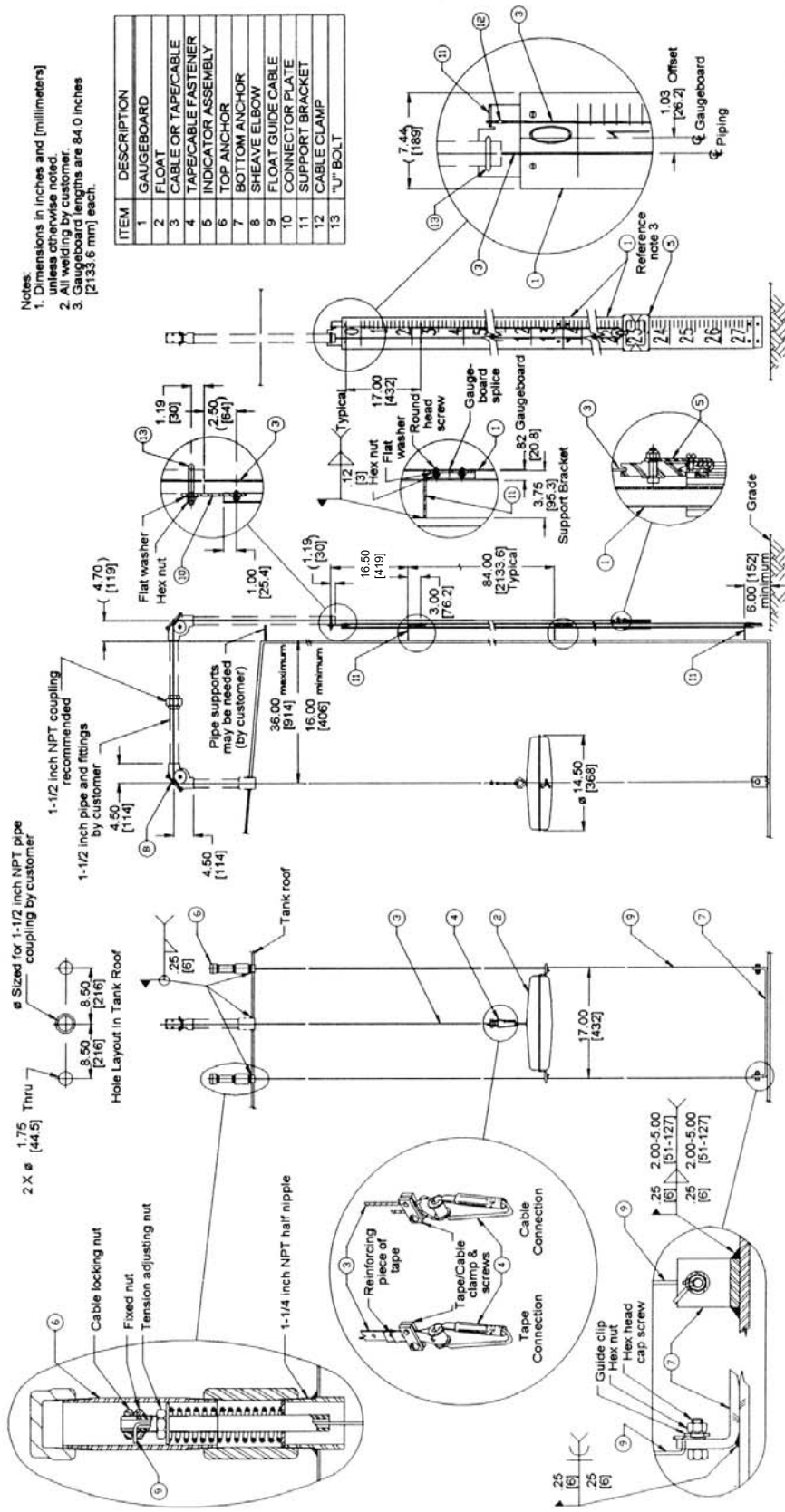


Figure 8: Half Travel Cone Roof Tank Installation

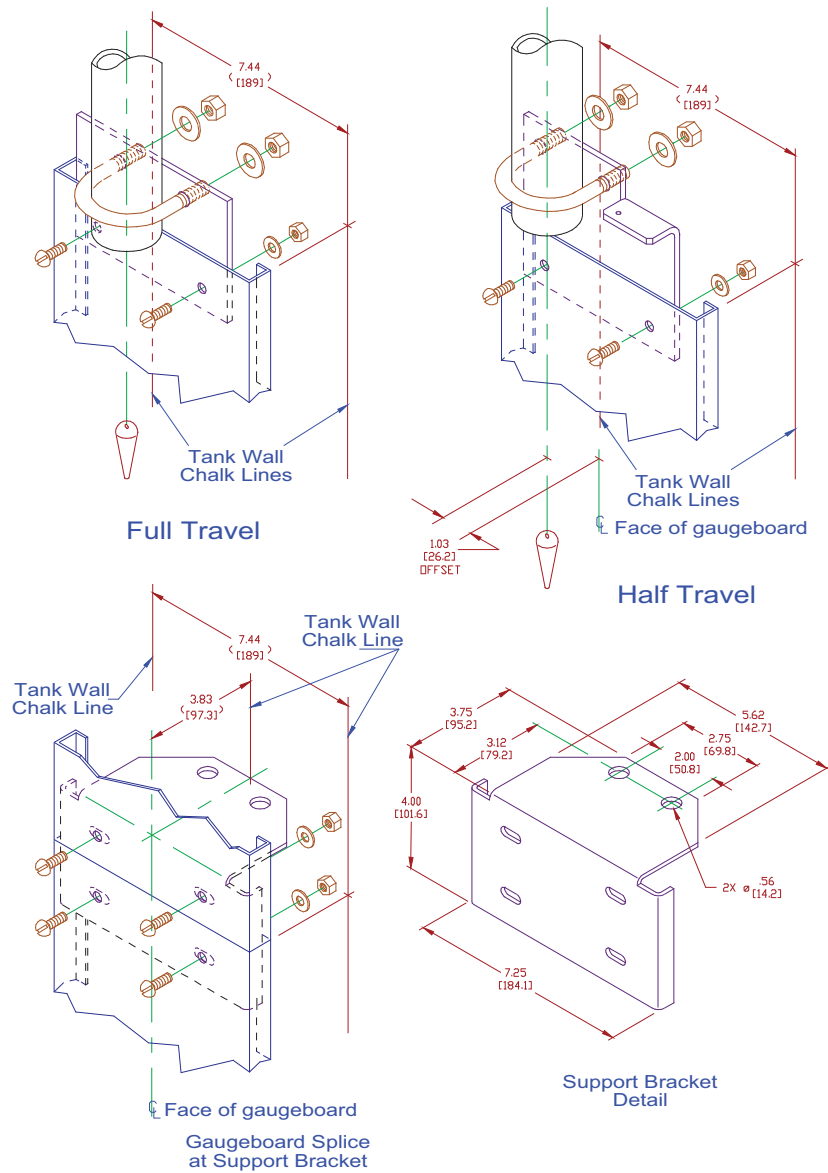


Figure 9: Gaugeboard Installation

ITEM	DESCRIPTION	PART NUMBER
1	CLIP	
2	JAM NUT	BM3612
3	HEX HEAD CAP SCREW	
4	CABLE	
5	PERFORATED TAPE	
6	CONNECTING CLAMP	
7	ROUND HEAD SCREW	BM5478-600
8	FLOAT CONNECTOR	
9	CABLE CLAMP (CRIMP TYPE)	B6065-006
10	BLOCK	
11	NUT ASSEMBLY	P004-02-002
12	SEAL CAP	

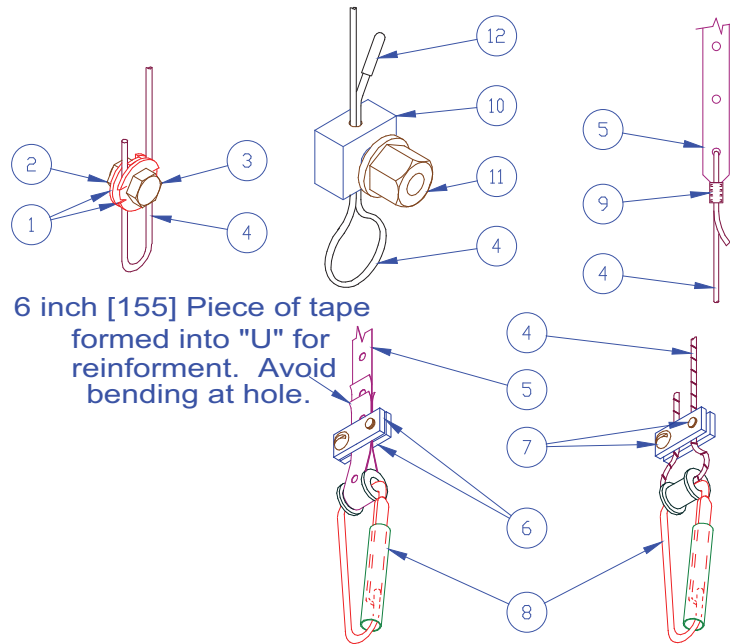


Figure 10: Tape/Cable Clamps

26. Tilt the float on edge and slip the guide cables through the loops on the inside of the tank. Set it on the tank bottom with the tape/cable connection up.
27. At the elbow on the tank entry pipe, unroll one or two turns of the tape/cable and start to feed it into the horizontal pipe. Continue to unroll the tape/cable several turns at a time until it reaches the ground at the bottom of the gaugeboard installation position. Make sure that the tape/cable on the ground does not become kinked or dirty.

Note Throughout these instructions the term “tape/cable” is used to designate either the indicator cable drive or the combination tape and cable drive that is used to also drive the accessory drive elbow. If the tape/cable combination is used, the cable end goes on the gaugeboard side.

28. Lower the tape cable to the tank bottom and let several inches fall on the tank bottom.
29. Temporarily attach the tape/cable to the float with the furnished fastener (see Figure 8 on page 17). Feed the other end of the indicator cable over the sheave in the elbow and make sure that it is seated on the pulley. Final attachment to be made at initial calibration.

30. Check the indicator tape/cable path between the float and the gaugeboard to be sure that the tape/cable is not kinked or twisted. Also check the float guide cables for kinks.
31. Make certain that the float guide cables are parallel.

Note If auxiliary equipment is to be installed, do it prior to crimping the cable connector. The accessory drive elbow should not be used for half-travel level indication. The use of auxiliary units not manufactured or supplied by Varec will void any Varec warranty and will relieve Varec of any obligation to service the product under warranty.

32. Install indicator.

Full Travel Gaugeboard:

Slip the indicator over the gaugeboard. Put the cable crimp on the end of the cable, then thread the cable through the hole in the indicator. Loop the cable on the outside back through the cable crimp and temporarily tape it to the crimp (see Figure 7 on page 16).

Half Travel Gaugeboard:

Remove one side channel from the indicator. Position indicator on the gaugehead and reassemble the side channel. Thread the cable through the pulley on the indicator. Put the cable crimp on the end of the cable. Thread the cable through the hole in the gaugeboard connector plate. Loop the cable on back through the cable crimp and temporarily tape it to the crimp (see Figure 8 on page 17).

33. Tape the gaugeboard indicator to the gaugeboard at 2.00 inches [50.8 mm] to hold it in place. Adjust the cable tension until the float barely lifts off the tank floor, then crimp the cable connector and remove the tape.

Note As the float is four inches [101.6 mm] high and its waterline is at its equator, it cannot register the last two inches [50.8 mm] of liquid in the tank.

34. Tie a line longer than the height of the tank to the indicator.

Caution Do not allow the float to fall back to the floor of the tank. Damage may result.

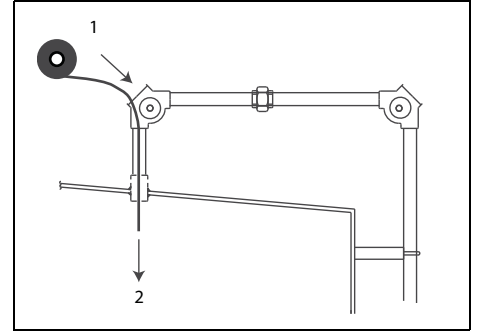
35. Slowly pull down on the indicator and lift the float to the top of the tank. Travel should not produce noticeable binding. Slowly lower the float to the floor of the tank.
36. Remove the pull line.

Connecting the Tape to the Float

Note Be sure to read this procedure before proceeding with this installation. Ensure you have completed all previous steps from your installation checklist before proceeding.

1. Using the box that the tape came in, pull the tape out like a measuring tape. This keeps the tape from becoming twisted or kinked.

Figure 11: Feed the Tape into the Tank



2. At the elbow on the tank entry pipe, unroll one or two turns of the perforated tape and start to feed it into the tank. If your installation is a roof-reading application with the gauge head installed on the conduit on the roof, feed the tape through the back of the gauge head first. Continue to unroll it several turns at a time until it reaches the bottom of the tank. Let several more inches fall on the tank bottom.
3. Cut a 6-inch (152 mm) piece of tape from the end inside of the tank. Form a 'U' with this piece of tape so there is no hole in the bottom portion of the 'U'. Do not kink.

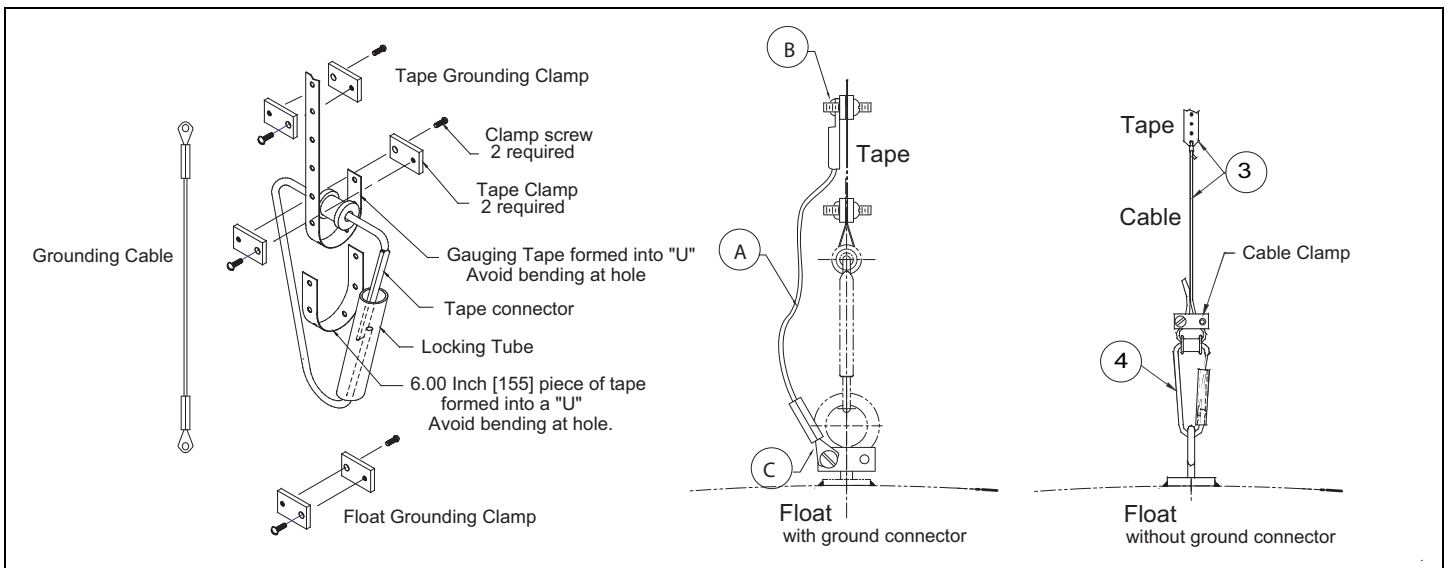


Figure 12: Tape Clamp Assembly with Grounding Cable

4. Form a 'U' at the end of the perforated tape. Form it to match the 'U' piece previously formed. Do not kink.
5. Install the gauge tape and 'U' piece to the tape connector with the tape clamps and screws provided, making certain that the tape is not kinked or twisted.
6. Connect the grounding cable (A) to the tape connector (point B).
7. Attach the tape connector to the float.
8. Connect the grounding cable (A) to the float (point C).

Initial Calibration

These instructions apply to systems that use a hollow-shell, welded float that is 14.5 inches [368 mm] in diameter by 4.0 inches [102 mm] deep. Calibration is based upon the standard specific gravity of water (1.0).

Note For products of other specific gravities to be gauged, adjust the indicator accordingly. Refer to the industry related charts for the particular product.

With the float just touching the bottom of the tank, water will be at the float equator (water line). Use the float connecting clamps (see Figure 7 on page 16) to make the final adjustment, then trim excess tape or cable at the float end, leaving some additional tape or cable for future adjustment needs.

Initial Lubrication

Apply a light oil to the elbow and indicator sheaves.

Reassembly

1. Reinstall the covers, gaskets, and bolts on the elbows.
2. Close the tank manholes and inspection covers.

Cone Roof Tank (Bolted Installation)

Note Be sure to read General Preparation at the beginning of this section before proceeding with this installation.

Refer to Table 2 on page 4. See Figure 15 on page 31.

1. Determine the position on the tank roof, beneath which the center of the float will rise and fall. Notice that this position is located a minimum of 16 inches [406 mm] and a maximum of 36.00 inches [914 mm] from the wall of the tank.
2. Provide the roof holes shown in the figure, centered on this position. The float diameter is 14.50 inches [368 mm]. The guide cable holes are centered 8.50 inches [216 mm], each side of the center of the float. The tape pipe is centered on a 17.00 inch [432 mm] diameter.
3. Check the angle of the roof. The roof pitch for the furnished gaugeboard is 1 inch [25.4 mm] in 12 inches [305 mm].
4. Connect a pipe deck flange to the 1.5-inch vertical pipe that is to be attached to the roof.
5. Bolt the flange to the roof. Check that it is plumb.

Note Failure to place the flange coupling and pipe in a true vertical position may affect the accuracy of the indicator. Make sure that the interior of all pipes are clean and free of corrosion.

6. After the deck flange and pipe are checked to make certain that they are plumb, unscrew the pipe from the coupling. Apply pipe thread compound and reconnect the pipe to the coupling.
7. Center the base of a top cable anchor in its hole. Hold it plum and bolt it to the roof. Do the same for the other top cable anchor.
8. Remove the housing nipple and cap from the top cable anchors and hang plumb lines from them at the center to mark the position where the bottom cable anchor will be attached. A hanging weight anchor may be ordered from Varec if it is not practical to bolt or weld the bottom guide cable anchor to the floor of the tank. For tanks that are in service, the hanging anchor must be used.
9. Mark the plumb bob string at the height of the tank bench mark. This will assure that the plumb bob just touches the bottom when the reference is made from the bench mark distance to the bottom.
10. Hang a plumb line through the center of the top tape/cable pipe to the bottom to mark the float center. This should be 8.50 inches [216 mm] at the bottom from each of the bottom cable anchor positions. When the positioning has been checked, attach the bottom cable anchor into place.

11. Thread the float cables into the tank through the top anchor fittings. Fasten them to the bottom cable anchors with the furnished hardware.
12. Thread the upper end of each guide cable through the top anchor assembly. Hand tighten. Use the lock nut to lock the cable in place, then tighten the adjustment nut, until the guide cable is tensioned by the spring.
13. Replace the housing nipple and cap.
14. Apply appropriate pipe thread compound and install the sheave elbow on the vertical pipe to the tank interior. Install a pipe union in the horizontal pipe run, in order that the elbows can be easily removed, if necessary. Then install the horizontal pipe assembly into the tank drop elbow. Adjust the length as needed to properly position the outboard elbow.
15. Install the outboard elbow on the horizontal pipe.
16. Apply pipe thread compound and screw the gaugeboard connector pipe into the outboard elbow.
17. Remove the bolts, cover, and gasket from the outboard elbow and drop a plumb line through the center.
18. Drop a chalk line from the top of the tank parallel with the plumb line and mark the chalk line on the tank wall. See Figure 9 on page 18.
19. Use the width of the gaugeboard at the bottom of the tank wall and chalk register marks for the width centered on the chalk line.
20. Do the same at the top of the tank.
21. Make chalk line marks between the top and bottom register mark to aid in keeping the gaugeboard sections centered and parallel during installation.
22. Bolt the gaugeboard support brackets into position (see Figure 9 on page 18). The first gaugehead support bracket mounts near the top of the tank. The others are spaced at seven foot [2.13.m] intervals except for the one at the bottom of the tank.
23. Use the “U” bolt and nuts (see Figure 9) to attach the gaugeboard connector to the pipe. The pipe should extend one inch [25.4 mm] below the “U” bolt.
24. Attach the top section of the gaugeboard to the connector plate. Make certain that it is centered on the chalk line.
25. Attach the remainder of the sections to the bottom of the tank. Make certain that each section is centered on the chalk line (see Figure 9 on page 18).

Note To fit the gaugeboard to the tank, cut the lowest gaugeboard section at the marker that is 4.50 inches greater than the tank height to adjust the fit to the total height to the tank

26. Tilt the float on edge and slip the guide cables through the loops on the inside of the tank. Set it on the tank bottom with the tape/cable connection up.
27. At the elbow on the tank entry pipe, unroll one or two turns of the tape/cable and start to feed it into the horizontal pipe. Continue to unroll the tape/cable several turns at a time until it reaches the ground at the bottom of the gaugeboard installation position. Make sure that the tape/cable on the ground does not become kinked or dirty.

Note Throughout these instructions the term “tape/cable” is used to designate either the indicator cable drive or the combination tape and cable drive that is used to also drive the accessory drive elbow. If the tape/cable combination is used, the cable end goes on the gaugeboard side.

28. Lower the tape cable to the tank bottom and let several inches fall on the tank bottom.
29. Temporarily attach the tape/cable to the float with the furnished fastener (see Figure 7 on page 16). Feed the other end of the indicator cable over the sheave in the elbow and make sure that it is seated on the pulley. Final attachment to be made at initial calibration.
30. Check the indicator tape/cable path between the float and the gaugeboard to be sure that the tape/cable is not kinked or twisted. Also check the float guide cables for kinks.
31. Make certain that the float guide cables are parallel.
32. Slip the indicator over the gaugeboard.
33. Put the cable crimp (see Figure 9) on the end of the cable, then thread the cable through the hole in the tank. Loop the cable on the outside back through the cable crimp and temporarily tape it to the crimp.

Note If auxiliary equipment is to be installed, do it prior to crimping the cable connector. The use of auxiliary units not manufactured or supplied by Varec will void any Varec warranty and will relieve Varec of any obligation to service the product under warranty.
34. Tape the gaugeboard indicator to the gaugeboard at 2.00 inches [50.8 mm] to hold it in place. Adjust the cable tension until the float barely lifts off the tank floor, then crimp the cable connector and remove the tape.

Note As the float is four inches [101.6 mm] high and its waterline is at its equator, it cannot register the last two inches [50.8 mm] of liquid in the tank.
35. Tie a line longer than the height of the tank to the indicator.

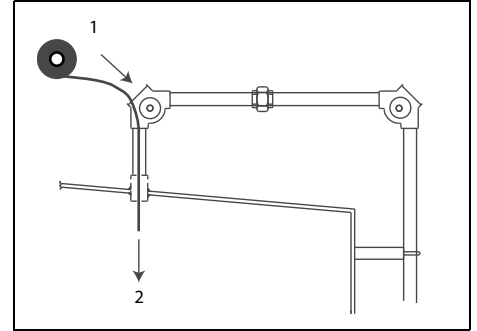
Caution Do not allow the float to fall back to the floor of the tank. Damage may result.
36. Slowly pull down on the indicator and lift the float to the top of the tank. Travel should not produce noticeable binding. Slowly lower the float to the floor of the tank.
37. Remove the pull line.

Connecting the Tape to the Float

Note Be sure to read this procedure before proceeding with this installation. Ensure you have completed all previous steps from your installation checklist before proceeding.

- Using the box that the tape came in, pull the tape out like a measuring tape. This keeps the tape from becoming twisted or kinked.

Figure 13: Feed the Tape into the Tank



- At the elbow on the tank entry pipe, unroll one or two turns of the perforated tape and start to feed it into the tank. If your installation is a roof-reading application with the gauge head installed on the conduit on the roof, feed the tape through the back of the gauge head first. Continue to unroll it several turns at a time until it reaches the bottom of the tank. Let several more inches fall on the tank bottom.
- Cut a 6-inch (152 mm) piece of tape from the end inside of the tank. Form a 'U' with this piece of tape so there is no hole in the bottom portion of the 'U'. Do not kink.

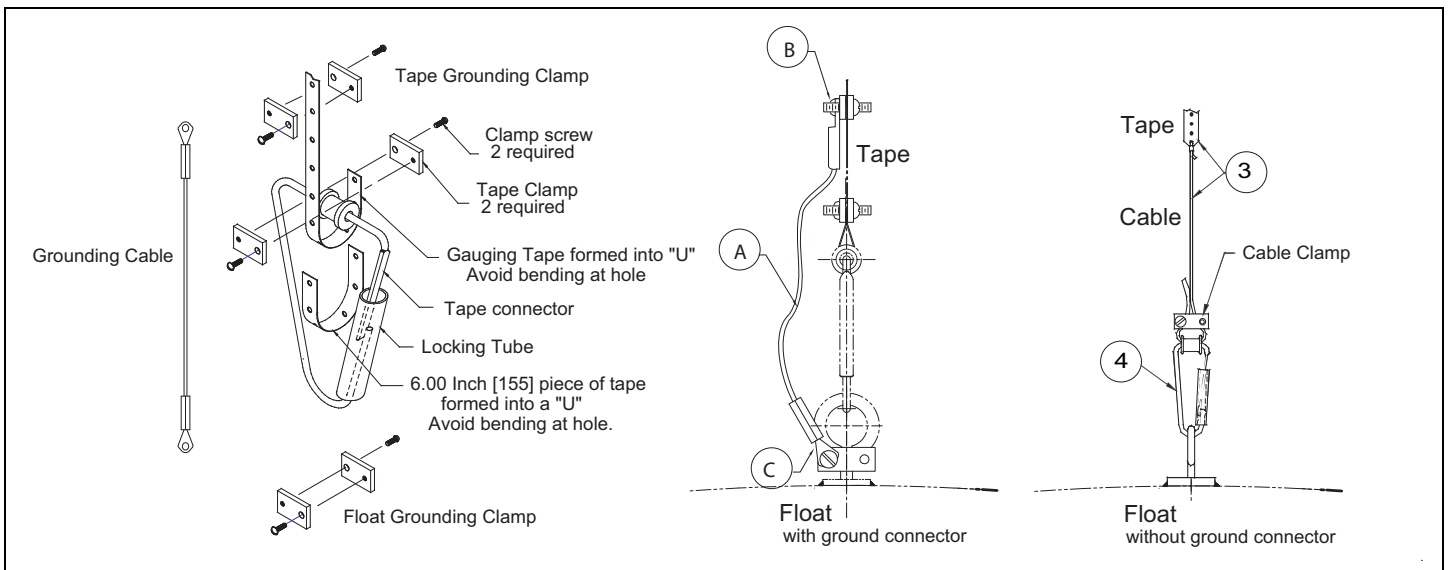


Figure 14: Tape Clamp Assembly with Grounding Cable

- Form a 'U' at the end of the perforated tape. Form it to match the 'U' piece previously formed. Do not kink.
- Install the gauge tape and 'U' piece to the tape connector with the tape clamps and screws provided, making certain that the tape is not kinked or twisted.
- Connect the grounding cable (A) to the tape connector (point B).
- Attach the tape connector to the float.
- Connect the grounding cable (A) to the float (point C).

Initial Calibration

These instructions apply to systems that use a hollow-shell, welded float that is 14.5 inches [368 mm] in diameter by 4.0 inches [102 mm] deep. Calibration is based upon the standard specific gravity of water (1.0).

Note For products of other specific gravities to be gauged, adjust the indicator accordingly. Refer to the industry related charts for the particular product.

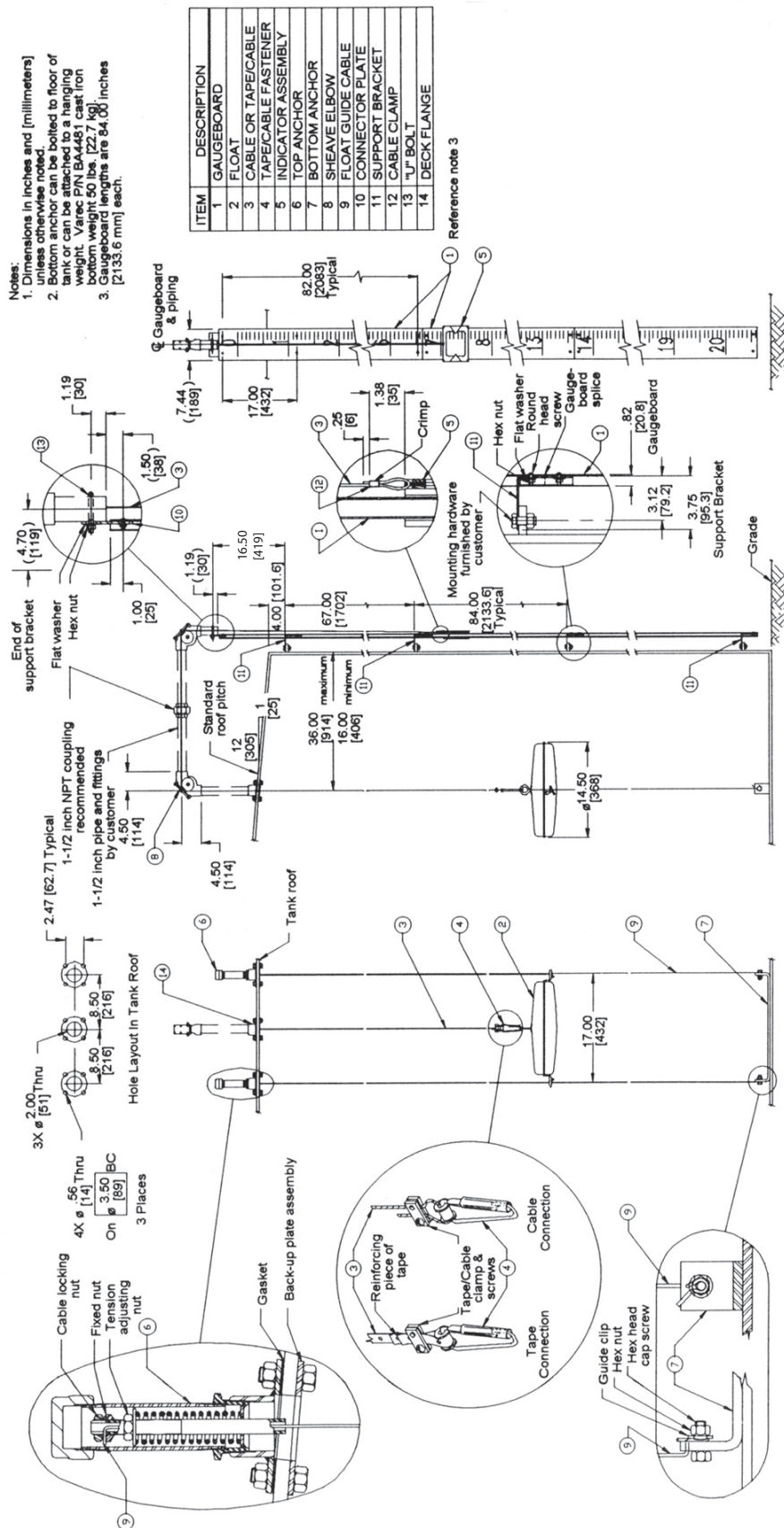
With the float just touching the bottom of the tank, water will be at the float equator (water line). Set the gaugeboard indicator to 2.00 inches [50.8 mm]. Use the float connecting clamps (see Figure 8 on page 17) to make the final adjustment, then trim excess tape or cable at the float end, leaving some additional tape or cable for future adjustment needs.

Initial Lubrication

Apply a light oil to the elbow and indicator sheaves.

Reassembly

1. Reinstall the covers, gaskets, and bolts on the elbows.
2. Close the tank manholes and inspection covers.



ITEM	DESCRIPTION
1	GAUGEBOARD
2	FLOAT
3	CABLE OR TAPE/CABLE
4	TAPE/CABLE FASTENER
5	INDICATOR ASSEMBLY
6	TOP ANCHOR
7	BOTTOM ANCHOR
8	SHEAVE ELBOW
9	FLOAT GUIDE CABLE
10	CONNECTOR PLATE
11	SUPPORT BRACKET
12	CABLE CLAMP
13	"J" BOLT
14	DECK FLANGE

- Notes:
1. Dimensions in inches and [millimeters] unless otherwise noted.
 2. Bottom anchor can be bolted to floor of tank or can be attached to a hanging weight. Varec P/N BA4451 cast iron bottom weight 50 lbs. [22.7 kg].
 3. Gaugeboard lengths are 84.00 inches [2133.6 mm] each.

Reference note 3

Figure 15: Bolted Tank Installation

Cone Roof Tank Installation (Fiberglass Tank)

Note Be sure to read General Preparation at the beginning of this section before proceeding with this installation.

Refer to Table 2 on page 4. See Figure 18 on page 38.

1. Determine the position on the tank roof, beneath which the center of the float will rise and fall. Notice that this position is located a minimum of 16 inches [406 mm] and a maximum of 36.00 inches [914 mm] from the wall of the tank.
2. Check the angle of the roof.
3. Lay out the coupling positions as shown in Figure 18. The float diameter is 14.50 inches [368 mm]. The guide cable couplings are centered at 8.50 inches [216 mm] each side of the float center. The indicator cable coupling is centered on a 17.00 inch [432 mm] diameter.
4. Install the couplings into the top of the tank in a vertical position. Lengths of pipe screwed into the couplings and held plumb will aid in proper orientation of these fittings. Failure to place the couplings in a true vertical position may affect the accuracy of the Liquid Level Indicator.
5. Make sure that the interior of all pipes are clean and corrosion free.
6. Use appropriate pipe thread compound on all pipe threads and install the 1-1/2 inch indicator pipe cable and the top cable anchors into their respective couplings.
7. Remove the housing nipple and cap from the top cable anchors and hang plumb lines from them at the center to mark the position where the bottom cable anchor will be installed.
8. Mark the plumb bob string at the height of the tank bench mark. This will assure that the plumb bob just touches the bottom when the reference is made from the bench mark distance to the bottom.
9. Hang a plumb line through the center of the top indicator cable pipe to the bottom to mark the float center. This should be 8.50 inches [216 mm] at the bottom from each of the bottom cable anchor positions
10. See Figure 18 for suggested bottom anchor configuration. When the position has been checked, install the bottom anchor into place.
11. Thread one end of the float guide cable into the tank through one of the top anchor fittings, through the bottom anchor channel and back up through the other top anchor fitting. Thread each end of the guide cable through the top anchor assembly, pulling the cable hand tight. Use the locking nut to lock the cable in place. Tighten the adjusting nuts on each anchor assembly evenly until the guide cable is tensioned by the spring. Trim off excessive cable.
12. Perform steps 13 - 21 under Cone Roof Tank Installation.
13. Install the gaugeboard support brackets into position. See Figure 18 and notice the relative position of the top bracket. All other support brackets are seven feet [2.436 meters] below the previous bracket, except for the last one which is a minimum of six inches [152 mm] above the grade line.
14. Perform steps 23 - 25 under Cone Roof Tank Installation.
15. Loosen the nut on each side of the float that secures the guide cable retainer. Rotate these retainers to open the key hole in the float cable guide. Position float with guide cables

routed through the float guide holes and rotate the guide cable retainers to lock the guide cable in place. Tighten the nuts and set the float on the tank bottom or bottom anchor.

16. Perform steps 27 - 32 under Cone Roof Tank Installation.
17. Tape the gaugeboard indicator to the gaugeboard at a level indication of 2.00 inches [50.8 mm] plus the height of the bottom anchor. Adjust the cable tension until the float barely lifts from its resting place. Crimp the cable connector and remove the tape.

Note As the float is four inches [101.6 mm] high and its waterline is at its equator, it cannot register the last two inches [50.8 mm] plus any bottom anchor height of liquid in the tank.

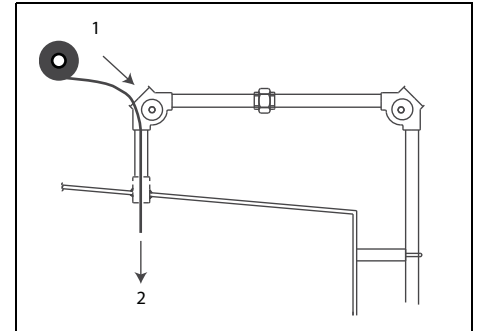
18. Complete the installation by performing steps 34 - 36 under Cone Roof Tank Installation.

Connecting the Tape to the Float

Note Be sure to read this procedure before proceeding with this installation. Ensure you have completed all previous steps from your installation checklist before proceeding.

1. Using the box that the tape came in, pull the tape out like a measuring tape. This keeps the tape from becoming twisted or kinked.

Figure 16: Feed the Tape into the Tank



2. At the elbow on the tank entry pipe, unroll one or two turns of the perforated tape and start to feed it into the tank. If your installation is a roof-reading application with the gauge head installed on the conduit on the roof, feed the tape through the back of the gauge head first. Continue to unroll it several turns at a time until it reaches the bottom of the tank. Let several more inches fall on the tank bottom.
3. Cut a 6-inch (152 mm) piece of tape from the end inside of the tank. Form a 'U' with this piece of tape so there is no hole in the bottom portion of the 'U'. Do not kink.

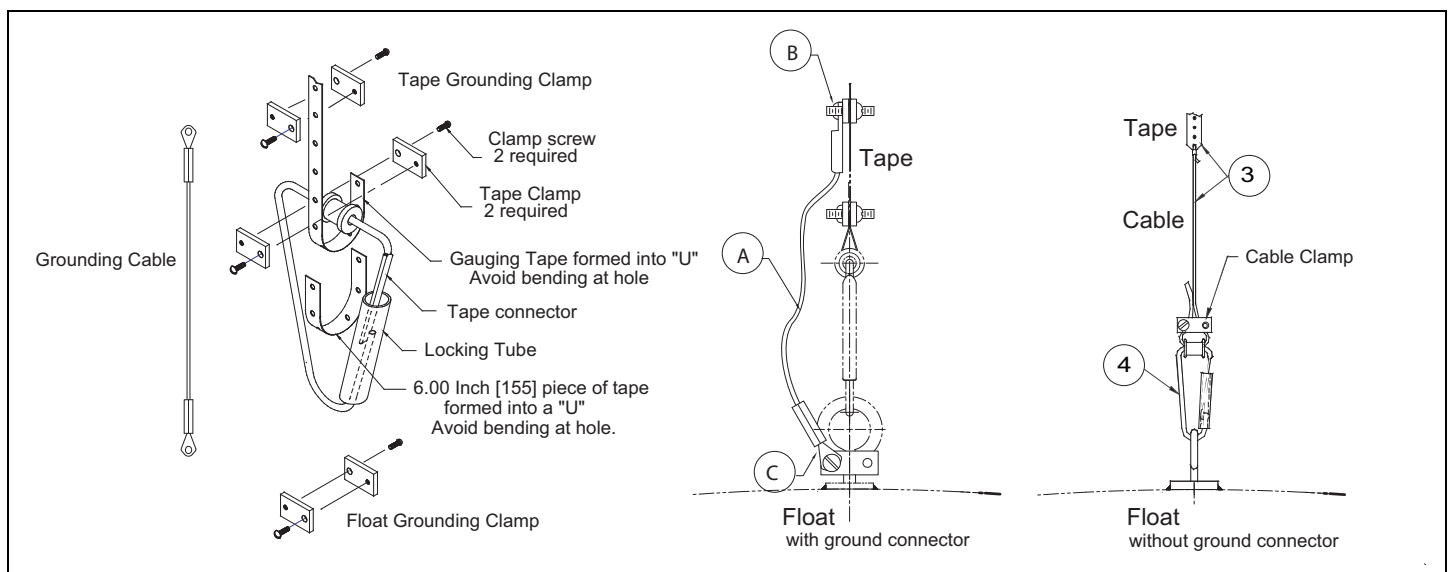


Figure 17: Tape Clamp Assembly with Grounding Cable

4. Form a 'U' at the end of the perforated tape. Form it to match the 'U' piece previously formed. Do not kink.
5. Install the gauge tape and 'U' piece to the tape connector with the tape clamps and screws provided, making certain that the tape is not kinked or twisted.
6. Connect the grounding cable (A) to the tape connector (point B).
7. Attach the tape connector to the float.
8. Connect the grounding cable (A) to the float (point C).

Initial Calibration

These instructions apply to systems that use a hollow-shell, fiberglass float that is 14.5 inches [368 mm] in diameter by 4.0 inches [102 mm] deep. Calibration is based upon the standard specific gravity of water (1.0).

Note For products of other specific gravities to be gauged, adjust the indicator accordingly. Refer to the industry related charts for the particular product.

With the float just touching the bottom of the tank, water will be at the float equator (water line). Use the float connecting clamps (see Figure 10 on page 19) to make the final adjustment, then trim excess tape or cable at the float end, leaving some additional tape or cable for future adjustment needs. Install the heat shrinkable seal cap over the cut end of the cable.

Initial Lubrication

Apply a light oil to the elbow and indicator sheaves.

Reassembly

1. Reinstall the covers, gaskets, and bolts on the elbows.
2. Close the tank manholes and inspection covers.

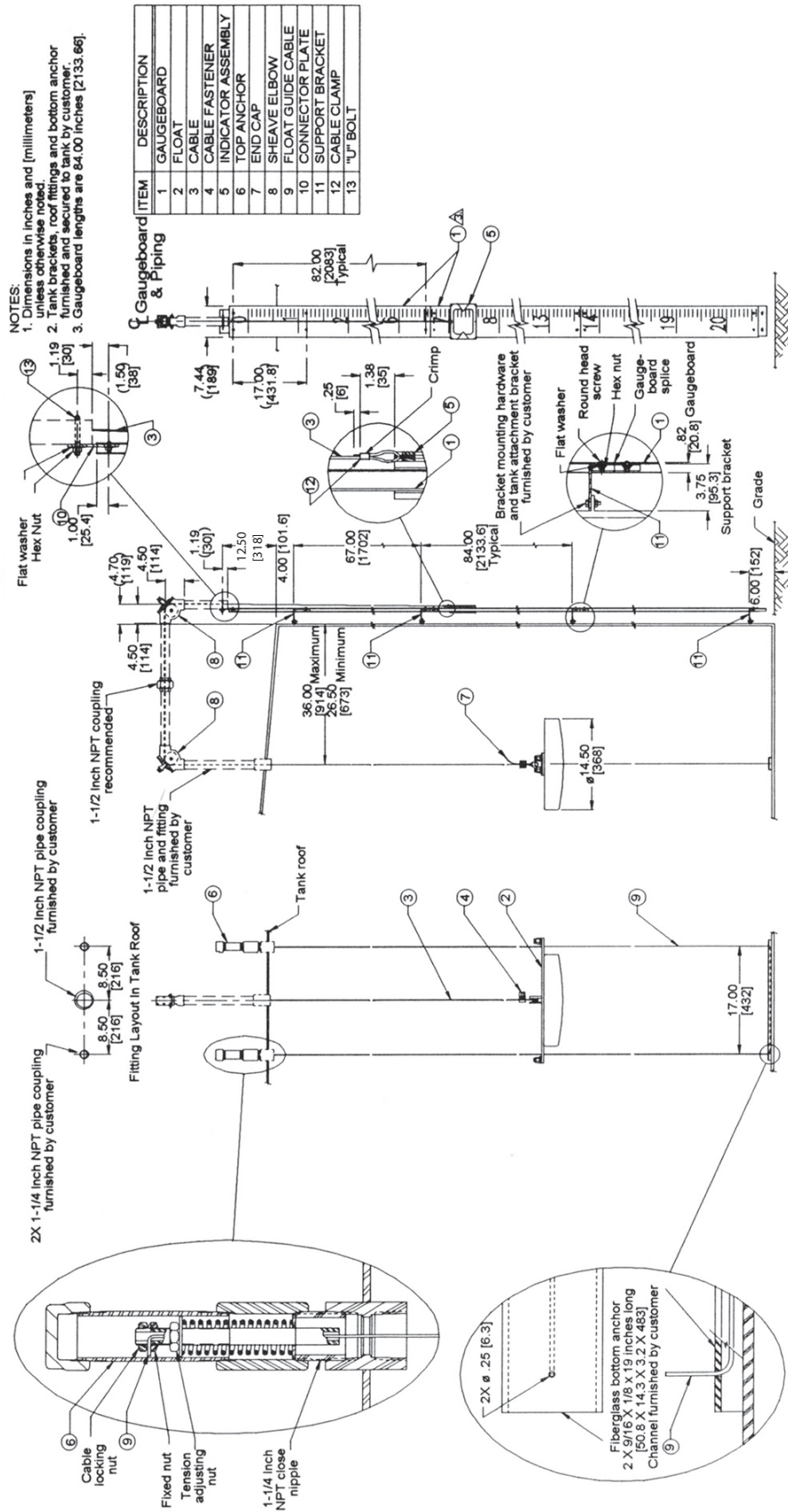


Figure 18: Fiberglass Cone Roof Tank Installation

In-service Tank Installations

This section covers the additional procedures that are required for making installations on tanks that are in service. Varec service contracts provide the user substantial savings for maintaining and refurbishing the systems. Contact Varec Product Marketing for further information.

General Preparation

Use the Table of Contents to determine the appropriate installation figure in this Instruction Manual. These are typical installations. All situations may not be covered. Contact Varec if additional information is needed.

Warning Make certain that the tank is empty and not in service. Ensure that the tank has been leak and pressure tested as appropriate for the liquid to be stored. Observe appropriate safety precautions in flammable or hazardous liquid storage areas. Do not enter a tank that has contained hydrocarbons, vapors, or toxic materials until a gas free environment is certified. Carry breathing equipment when entering a tank where oxygen may be displaced by carbon dioxide, nitrogen, or other gases. Wear safety glasses as appropriate. Use a hard hat.

Warning Under most circumstances, the mechanical connections between the guide cables and the anchors provide a resistance to ground that is adequate for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product. Additional grounding may be needed for products with low flash points. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard. Observe American Petroleum Institute (API) Recommended Practice 2003 or other appropriate industry or military standard.

The user provides the 1.5-inch pipe that carries the tape/cable and the necessary mounting and support welding. The user must drill holes as needed.

Assemble the necessary tools and equipment at the work site. Refer to Table 6 on page 10 for suggested tools and equipment. Plan the pipe routing. Position the roof connection installation into the tank interior within arms reach of a manhole or an inspection hatch.

Use these procedures to install a Varec manhole or inspection hatch, if there is none located within arms reach of the tape pipe location.

Locate the float at a position inside of the tank where surface agitation on it will be at a minimum. Install a deflector, if the product stream is close to the float. Contact Varec if agitators will cause excess float disturbances. Vertical pipe runs must be plumbed and perpendicular to prevent the tape/cable from binding inside the pipe.

The user must attach the gaugeboard to the tank by welding or bolting the supplied gaugeboard brackets. If the environment is such that welding cannot be performed, the user can construct a support structure close to the outside of the tank.

Warning The user should comply with all applicable regulations, codes, and standards. For safety precautions, the user should refer to the appropriate industry or military standards.

Independent Pipe Support Structure

Where the environment is such that welding cannot be performed, construct an appropriate support structure of 3-inch [76 mm] pipe in segments away from the tank and weld the

brackets there. Use good commercial practices. Make certain that vertical segments will be plumb and the horizontal segments level. Use a concrete footing to support the tankside vertical segment (see Figure 19 on page 42).

Installation of Model 228 Inspection Hatch to Existing Manhole Cover

See Figure 19 on page 42 to modify an existing manhole cover with a model 228 (Part Number BM6746) type inspection hatch.

1. Remove the cover to a safe welding location.
2. Cut a rectangular hole 6.00 inches [152 mm] x 15.75 inches [400 mm] in the cover.
3. Cut a 2.50-inch [63.5 mm] diameter hole in the cover to carry the tape drop pipe.
4. Cut two 1.75-inch [44.5 mm] diameter holes in the cover to carry the top guide cable anchors.
5. Disassemble the inspection cover and gasket from the frame.
6. Weld the inspection cover frame to the manhole cover.
7. Weld the guide cable anchor nipples and the tape/cable drop pipe coupling in place. make certain that they are vertical and correctly centered.
8. Carry the modified cover assembly back to the tank site. Orient the modified manhole cover as shown and reinstall.
9. Refer to the appropriate tank configuration figure and install the tape/cable piping and gaugeboard.

Anchor Bar Installation

Varec supplies an anchor bar for in-service installations (Part Number BA4481) that must be ordered separately. It is for normal service only. The guide cables fasten to the anchor bar with cable clamps (see Figure 19 on page 42). For severe or extreme service installations, contact Varec. A severe service installation is shown in Figure 20 on page 43.

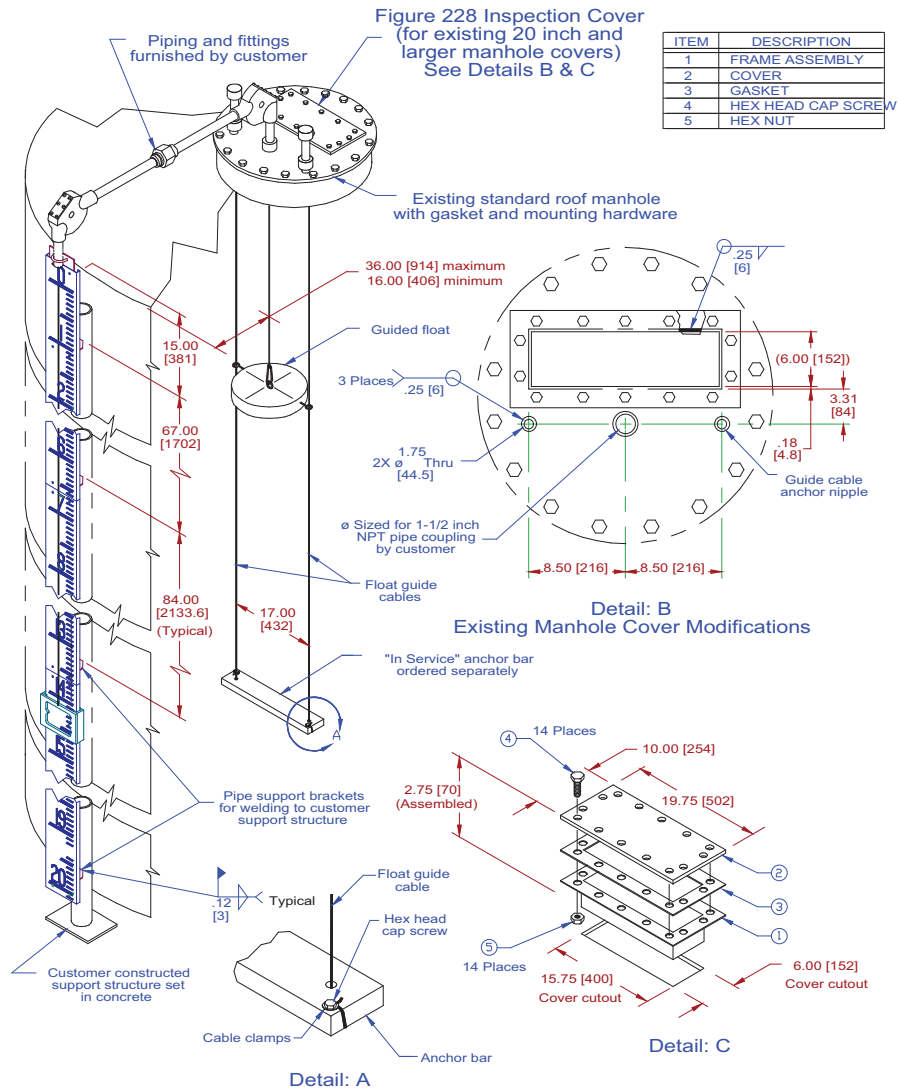


Figure 19: Typical In-Service Tank Installation

Float Installation

1. Refer to appropriate tank configuration and install top anchors less long nipple and cap.
2. Thread the float guide cables into the tank through the top anchor fittings and pull the ends back through the inspection hatch.
3. Fasten the bottom anchor to the guide cables (see Figure 18 on page 38) and lower the anchor slowly through the inspection hatch into the tank.
4. When anchor bar is resting on tank bottom, remove cable slack by hand. Tighten cable locking nut to secure cable in place.
5. Tighten the adjustment nut until the guide cable is tensioned by the spring. Trim excess cable.
6. Use pipe thread compound and install top anchor nipples and cap.

Note Throughout these instructions the term “tape/cable” is used to designate either the indicator cable drive or the combination tape and cable drive that is used to also drive the accessory drive elbow. If the tape/cable combination is used, the cable end goes on the gaugeboard side.

Caution If the tape/cable binds in the pipe during threading, check the pipe for corrosion and other obstructions. Check the tape/cable to make certain that it did not kink. Friction in the pipe will affect accuracy and may break the tape/cable.

7. Thread the tape/cable through the horizontal pipe and into the gaugeboard connector pipe.
8. Put a clean drop cloth on the ground and push the tape through a few turns at a time from the drop pipe elbow, until the tape/cable is unrolled. Make sure that the tape/cable falling to the ground does not become kinked or dirty.
9. Use the tank bench mark as a guide and pull back enough tape/cable to drop from the bench mark to the tank bottom. Mark that position on the tape for reference.
10. Thread the tape through the drop pipe into the tank and pull the end back through the inspection hatch.
11. Install the tape/cable to the float connector with the clamps and screws provided (see Figure 10 on page 19).
12. Attach the tape/cable connector to the float, pass it through the hatch and attach the eyes to the guide cables.
13. Attach the grounding wire to the float as described in Connecting the Tape to the Float on page 34.

Caution Do not allow the float to fall to the surface of the product. Damage may result.

14. Lower the float until it is hanging from the tape/cable. Inspect the tape/cable and cables for twists and kinks. Make sure that the cables are parallel, then lower the float to the surface of the product.
15. Make a hand gauge measurement of the tank product level. Use the bench mark reference to calibrate the hand gauge. Use extra care to make certain that this measurement is accurate because the accuracy of the sight gauge indicator depends upon it.
16. If an accessory is to be installed, perform the installation. Refer to the main text auxiliary equipment installation paragraphs and then continue the installation. The hole size, bolt

pattern, and coupling of Varec accessories mates with the sheave drive elbow. Each mating auxiliary unit has a slotted coupling that engages the drive pin on the sprocket sheave. Mate the accessory with the sprocket sheave drive. Use the hex head cap screws and washers to attach the accessory unit to the drive elbow.

Refer to the manual for the accessory unit, if installed, and check out the operation of the accessory as appropriate.

Note The use of auxiliary units not manufactured or supplied by Varec will void any Varec warranty and will relieve Varec of any obligation to service the product under warranty.

17. Install the gaugeboard and indicator. Refer to the appropriate tank configuration.
18. Set indicator at measured product level.
19. Adjust the tape/cable tension until the float barely lifts from its natural floating position, then crimp the cable connector.
20. Tie a line to the indicator.
21. Slowly pull down on the indicator and lift the float to the top of the tank. Travel should not produce noticeable binding. Slowly lower the float to the product level. Check that any installed accessory performed properly during this test.

Caution Do not allow the float to fall to the surface of the product. Damage may result.

22. Refer to appropriate tank configuration to set the indicator at the full tank position, then use the hand gauge measurement to recheck the current product level.

Initial Lubrication

Apply a light oil to the elbow and indicator sheaves.

Reassembly

1. Reinstall the covers, gaskets, and bolts on the elbows.
2. Close the tank manholes and inspection covers.

Installation of Model 226 for 20 and 24 Inch Manhole Covers with API Drilling

See Figure 2 on page 33 to install Model 226 20 inch (Part Number BM3443) and 24 inch (Part Number BM3607) manhole covers with API drilling.

1. Remove the existing manhole cover.
2. Separate the Model 226 cover by removing the flange connecting bolts.
3. Install the cover half with the pipe coupling to the top of the tank.
4. Refer to the appropriate tank configuration figure to check the tank configuration and install the tape/cable piping and gaugeboard.

Complete the Anchor Bar Installation, Float Installation, Initial Lubrication, and Reassembly sections of the previous procedure, Installation of Model 228 Inspection Hatch to Existing Manhole Cover. See also the following section, Typical Auxiliary Equipment Installation.

Typical Auxiliary Equipment Installation

To install auxiliary equipment, an auxiliary elbow drive adapter kit (P/N 13-08821) is required. The kit contains the English drive elbow (P/N BM4129) and the tape/cable combination (P/N B7678-106). This has a sprocket sheave that is driven by the English tape/cable combination. Usually this is installed on the outboard connection pipe elbow.

Note The use of auxiliary units not manufactured or supplied by Varec will void any Varec warranty and will relieve Varec of any obligation to service the product under warranty.

The perforated tape portion of the tape/cable combination must be seated on the sprocket sheave throughout the travel of the indicator. The cable portion cannot drive an auxiliary device. The cable portion attached to the pulley of the half-travel indicator may reach the gaugeboard connector sheave before a vertical tank is empty if the gaugeboard is mounted high on the tank.

1. Remove the bolts, cover, and gasket from the elbow.
2. Remove the drive adapter flange bolts, washers, flange cap, and gasket.
3. Install the elbow on the indicator connector pipe.
4. Refer to the appropriate tank configuration installation procedures above and thread the tape/cable through the elbow. The cable segment attaches to the gaugeboard indicator.

The tape segment attaches to the float. Position the tape/cable splice below the auxiliary drive elbow with the float at the bottom of the tank.

5. Seat the perforated tape portion of the tape/cable combination on the sheave sprocket and thread it through the indicator connector pipe.
6. Attach the auxiliary unit to the adapter flange.
7. Attach the auxiliary unit with adapter flange to the drive elbow ensuring that the sprocket drive pin engages the slotted coupling of the auxiliary unit.
8. Refer to the auxiliary unit manual for operation and checkout procedures.
9. Refer to the appropriate tank configuration to complete the installation.

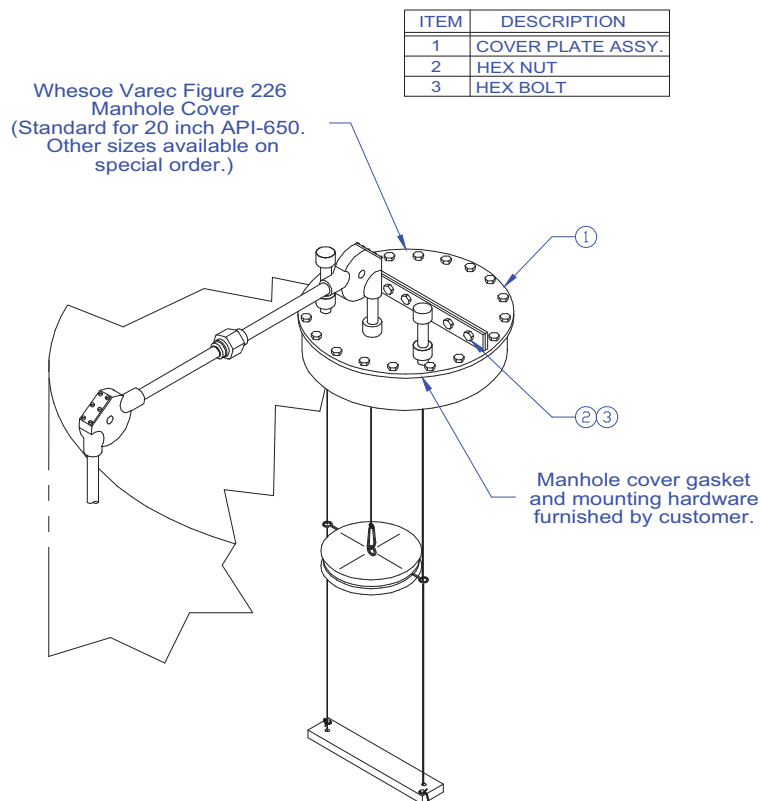


Figure 21: API 20/24-Inch Manhole cover Installation

Operation

Initial Operation

Caution Initial filling of the tank must be a reduced rate of flow, until the float travel and sight indicator operation are verified. This checks that the installation was correctly made and prevents possible damage to the gauge system. On floating roof tanks this is particularly important because the tape/cable travel has not been checked during the installation.

1. Station an observer at the gaugeboard.
2. Begin filling the tank to raise the float several feet (about three feet or one meter) from the bottom.
3. Continue filling the tank to the desired level.
4. Hand gauge the product and compare the measurement with the gaugeboard indication. If they do not coincide, adjust the cable at the indicator or connector plate. Use the spare cable crimp, if necessary.

Normal Operation

When the tank is full, the indicator is at the bottom of the gaugeboard. As the liquid is removed from the tank, the float falls and the indicator rises.

Calibration and Volume Measurement

Tank gauging measurements provide appropriate inventory checks and a valuable method of checking marine receipts and metered custody transfers. Accuracy of measurements requires that a number of factors be considered:

- Density and specific gravity of product as determined from representative samples
- Sediment in the tank
- Water content in the product
- Gross volume
- Temperature of the product
- Tank-bottom deformation

It is the user's responsibility to appropriately consider these and other factors in his application. For example, oil tank capacity tables are calculated for product at 60° F. A higher temperature will cause the tank to expand and the actual volume will be greater than the volume at the standard temperature.

Table 7: API Standards

API Standard	Description
2550	Method For Measurement And Calibration Of Upright Cylindrical Tanks (ANSI/ASTM D1220)
2545	Method of Gauging Petroleum and Petroleum Products (ANSI/ASTM D1085)
2540	Chapter 11.1 (ANSI/ASTM D1250) for Volume Correction Factors. Refer also to API 2545.
Manual of Petroleum Measurement Standards, Chapter 3 - Tank Gauging, Section 1B, Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging.	

Accuracy of hand gauging is extremely important, as it is used to set the Varec Liquid Level Indicator. Careful reference to the benchmark of the tank assures accuracy of the levels as they are read from the indicator during operation.

Maintenance

Periodic Maintenance

Varec Model 6700 Low Pressure Liquid Level Indicators are designed for long service life. Like any other measuring device, Liquid Level Indicators require regular, periodic service to maintain the original performance. Table 8 on page 52 provides some suggested periodic service. Minimum maintenance lengthens the service life and assures more accurate reading of the indicator.

Varec provides maintenance service contracts that provide regular periodic inspection and maintenance at substantial savings. Some repair tasks may require special tools.

Warning Observe appropriate safety precautions in flammable or hazardous liquid storage areas. Do not enter a tank that has contained hydrocarbons, vapors, or toxic materials, until a gas-free environment is certified. Carry breathing equipment when entering a tank where oxygen may be depleted with carbon dioxide, nitrogen or other gases.

Electrostatic Discharge Hazard

Under most circumstances, the mechanical connections between the guide cables and anchors provide a resistance to ground that is adequate for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product. Additional grounding may be needed for products with low flash points. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard. Observe American Petroleum Institute (API) Recommended Practice 2003 or other appropriate industry or military standard.

Lubrication

Lubricate moving parts of the elbow and indicator sheaves at regular intervals. Use a light-weight oil.

Oil Recommendations for Oil Seal Accessory Units

GENERAL SERVICE

- Low pour point, food grade, water white, mineral oil.

SERVICE BELOW 25 °F (-4 °C)

- Automotive antifreeze compatible with aluminum and water (50/50 mix)

Caution These oils may not be compatible with edible oils and potable liquids. Use product compatible substitutes for tanks holding products for human or animal consumption or products that may react chemically with the oil.

Table 8: Suggested Periodic Maintenance Schedule

Routine	90 Days	6 Months	1 Year	5 Years
Operation check	X	X	X	
Guide cables		X	X	
Float		X	X	
Lubricate			X	
Leak check	X	X	X	
Change oil			X	
Calibration		X	X	
Corrosion check			X	
Sediment check	X	X	X	
Deformation check	X	X	X	
Refurbish				X

Inspection

It is recommended that the first inspection after the unit has been placed in service be made at the end of the first thirty-day period. Oil sealed units should be inspected immediately after being placed in service and then daily for the first week. Subsequent inspections should be made every 90 days (Table 8). The user may adjust the schedule for his own convenience and safety, depending upon the product. Varec maintenance service contracts are available for 90-day, 6-month, 1-year and 5-year periods at substantial savings.

Troubleshooting Common Problems

Friction is a common problem that affects indicator accuracy. Some liquids produce corrosion in the mechanism. Periodic inspection and maintenance provided by a Varec service contract

can prevent problems from occurring. Periodic cleaning, lubrication, and replacement of worn parts stops trouble before it starts.

Table 9: Indicator at Ground Level (Tank Not Full)

	Possible Cause	Action
1	Cable broken?	Yes Replace cable. No Go to 2.
2	Float detached?	Yes Re-attach.

Table 10: Gaugeboard Indicator Stopped

	Possible Cause	Action
1	Cable stuck?	Yes: <ul style="list-style-type: none"> • Check cable path. • Check for frozen sheave shafts (repair/replace). • Check for frozen accessory shafts (repair/replace). No: <ul style="list-style-type: none"> • Go to 2.
2	Pipes dirty?	Yes: <ul style="list-style-type: none"> • Clean with automotive type spray degreaser. No: <ul style="list-style-type: none"> • Go to 3.
3	Indicator or gaugeboard slides dirty or damages?	Yes <ul style="list-style-type: none"> • Clean. Repair/replace.

Table 11: Calibration Repeatability Unstable

	Possible Cause	Action
1	Indicator or gaugeboard slides dirty or damaged?	Yes: <ul style="list-style-type: none"> • Clean with automotive type spray degreaser. Repair/replace. No: <ul style="list-style-type: none"> • Go to 2.
2	Tape/cable off elbow pulley?	Remove elbow covers. Yes: <ul style="list-style-type: none"> • Reseat and lubricate pulley shafts. No: <ul style="list-style-type: none"> • Go to 3.

Table 11: Calibration Repeatability Unstable

	Possible Cause	Action
3	Pulley shaft/ bushing worn/ corroded?	Yes: <ul style="list-style-type: none">• Repair or replace. No: <ul style="list-style-type: none">• Go to 4.
4	Cable pipe/ conduit dirty?	Yes: <ul style="list-style-type: none">• Remove and clean. No: <ul style="list-style-type: none">• Go to 5.
5	Guide cables loose, kinked or broken?	Yes: <ul style="list-style-type: none">• Tighten, repair or replace.

Specifications

Liquid Level Indicator

Table 12: Liquid Level Indicator Specifications

Indicator Gaugeboards:	Aluminum Alloy
Indicator Sight Target:	Type 304 Stainless Steel and UHMW Polyethylene
Half Travel Sheave:	UHMW Polyethylene
Float Cable:	Type 316 Stainless Steel
Float Cable Clamp:	Type 316 Stainless Steel
Float Tape/Cable (Elbow Drive Kit):	Type 316 Stainless Steel
Gauge Float:	Type 316 Stainless Steel

Standard Installation Kits

Table 13: Standard Installation Kit Specifications

Mounting Brackets:	Steel
Elbow Sheave Housing & Cover:	360 Aluminum
Elbow Sheave Wheel:	Delrin
Top Anchor:	Steel
Top Anchor Spring:	Zinc Plated Steel
Bottom Anchor:	Steel
Guide Cable:	3/32" Diameter Type 316 Stainless Steel

Standard Float Specifications

Table 14: Standard Float Specifications

Material:	Type 316 S. S.
Diameter:	14.5 inches (36.8 mm)
Eyelet Centers:	17 inches (43.2 mm)
Net Weight:	8.8 lbs. (3.99 kg)

Bottom Anchor Bar Weight

Table 15: Bottom Anchor Bar Weight

Weight:	52 lbs. (22.2 kg)
Material:	Steel Also, available in 304SS and 316SS

Other Specifications

Table 16: Other Specifications

Operating Range:	Full Travel • 62 ft. [23 M] Maximum Half Travel • 97 ft. Maximum (English Only)
Service Rating:	Atmospheric
Pipe Connections:	1 1/2 inch NPT

Reference Part Numbers

Indicator Part Numbers

Table 17: Indicator Part Numbers

Part Number	Type	Service
06-09830	Full Travel	All
06-09831	Half Travel	All

Float Part Numbers

Table 18: Float Part Numbers

Part Number	Type	Service
BM9074-000	316 S.S.	Normal/Severe
BM12338-000	Monel	Extreme
BM12339-000	Carpenter 20	Extreme
P29-43	Fiberglass	Extreme

Sheave Elbow Part Numbers

Table 19: Sheave Elbow Part Numbers

Part Number	Description	Service
06-08564	Aluminum 90°	Normal
BM3480	Aluminum 135°	Normal
BM3481	Aluminum 180°	Normal
BM4675	Cast Iron 90°	Severe/Extreme
BM4129	Elbow Drive, Aluminum	Normal, English
BM8514	Elbow Drive, Aluminum	Normal, Metric

Bottom Anchor Bar Weight Part Number

Table 20: Bottom Anchor Bar Weight Part Number

Part Number	Description	Service
BA4481	Carbon Steel Bottom Guide Wire Anchor Assembly (2 Wire)	Normal
BA4482-005	304SS Bottom Guide Wire Anchor Assembly	
BA4482-006	316SS Bottom Guide Wire Anchor Assembly	

Oil Seal Accessory Part Numbers

Table 21: Oil Seal Accessory Part Numbers

Assembly Part Number	Type	Service
10-01994-AAA	Aluminum, Working Pressure 8.5 in. W.C.	Normal
10-01994-BAA	Iron Working Pressure 8.5 in. W.C.	Severe
10-02861-AAA	Aluminum Working Pressure 27 in. W.C.	Normal

All pipes are steel.

Order Codes

Order Code Table

Application Type	
BL	For application on bolted tank type
SS	For corrosive or clean liquids, (Stainless steel kit-wetted parts)
ST	For application on standard tank type
SV	For corrosive chemical storage, (severe service kit-wetted parts)
AP	For asphalt storage

Board Type and Length	
F06	English - Tank to 6 ft
F13	English - Tank to 13 ft
F20	English - Tank to 20 ft
F27	English - Tank to 27 ft
F34	English - Tank to 34 ft
F41	English - Tank to 41 ft
F48	English - Tank to 48 ft
F55	English - Tank to 55 ft
F62	English - Tank to 62 ft
H13	English - Tank to 13 [12.75] ft-half travel
H27	English - Tank to 27 [26.75] ft-half travel
H41	English - Tank to 41 [40.75] ft-half travel
H55	English - Tank to 55 [54.75] ft-half travel
H69	English - Tank to 69 [68.75] ft-half travel
H83	English - Tank to 83 [82.75] ft-half travel
H97	English - Tank to 97 [96.75] ft-half travel
M02	Metric- Tank to 2 [1.940] m
M04	Metric- Tank to 4 [3.890] m
M06	Metric- Tank to 6 m
M08	Metric- Tank to 8 m
M10	Metric- Tank to 10 m
M12	Metric- Tank to 12 m
M14	Metric- Tank to 14 m
M16	Metric- Tank to 16 m

Board Type and Length			
		M19	Metric- Tank to 19 m
		M21	Metric- Tank to 21 m
		N23	Metric- Tank to 23 m
		Y	Special Version
N6700			Complete Product Designation

