



CONTENTS

1.0 GENERAL	
1.1 Model Number	2
1.2 Materials of Construction	2
1.2.3 Pressure Temperature Rating	3
1.2.4 Gauge Lengths / Weights	4
1.3 Dimensions.....	5
2.0 INSTALLATION	
2.1 Assembly	6
3.0 OPERATION	
3.1 Theory of Operation	6
4.0 MAINTENANCE	
4.1 Preventive Maintenance	7-8

Model 3520/3540

Installation, Operation, and Maintenance Instructions

1.0 GENERAL

1.1 Model Number Information

Sample Model Number: 3520 - 15 R B1 - 1 S

RATING	CODE
Medium Pressure (Table 1)	20
High Pressure (Table 2)	40
LENGTH CODE- see Table 3	CODE
(example)	15
STYLE	CODE
Reflex	R
Transparent	T
CONNECTION	CODE
1/2" Top – Bottom	B1
3/4" Top – Bottom	B2
1/2" Side – Side (Close-hookup)	C1
3/4" Side – Side (Close-hookup)	C2
MOUNTING	CODE
None	0
Style 1	1
Style 2	2
Style 3	3
Style 4	4
COATING OPTION	CODE
Standard	S
Marine	M

1.2 Materials of Construction

Liquid Chamber:

- Standard: Carbon Steel
- Optional: 316 SST, 316L SST, Monel, and Brass

Cover:

Carbon Steel
Bolts and Nuts

- Standard: Steel, "black oxide" treated to prevent rust
- Optional: 316 SST (Marine option)

Glass:

Tempered Borosilicate (to 600°F) or
Aluminosilicate (to 800°F)

Gaskets:

Bonded Compressed Fibers or Glass
Filled PTFE

1.2.3 Pressure / Temperature Ratings

Table 1. Model 3520

Temp (° F)	Maximum Pressure (psi)																	
	Reflex Gauge									Transparent Gauge								
	Glass Size									Glass Size								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
100	3270	3140	3000	2880	2750	2630	2510	2390	2250	2000	1850	1750	1600	1500	1350	1250	1100	1000
200	3090	2970	2860	2740	2620	2500	2380	2260	2150	1900	1780	1660	1550	1440	1300	1175	1060	950
300	2900	2790	2670	2560	2450	2340	2220	2110	2000	1770	1660	1550	1450	1330	1220	1100	1000	900
400	2700	2600	2490	2380	2270	2170	2060	1950	1850	1675	1575	1470	1350	1250	1150	1050	925	850
500	2510	2410	2305	2205	2100	2000	1900	1800	1700	1530	1450	1350	1250	1150	1050	950	850	750
600	2285	2190	2100	2010	1915	1820	1730	1640	1550	1350	1275	1180	1100	1010	925	850	750	675
	Saturated Steam rating 300 WSP ¹									Saturated Steam using Mica 750 WSP ¹								

1. For temperatures above 600°F, aluminosilicate glass MUST be used.

Table 2. Model 3540

Temp (° F)	Maximum Pressure (psi)	
	Reflex Gauge	Transparent Gauge
	Glass size 1 thru 9	Glass size 1 thru 9
100	4000	3000
200	3890	2920
300	3790	2850
400	3700	2780
500	3470	2600
600	3080	2310
	Saturated Steam rating 300 WSP ¹	Saturated Steam using Mica 750 WSP ¹

1. For temperatures above 600°F, aluminosilicate glass MUST be used.

Model 3520/3540

Installation, Operation, and Maintenance Instructions

1.2.4 Gauge Lengths / Weights

Table 3.

Length Code	No. of Sections	Glass Size	Visible Range	Overall Length	Approximate Weight	
			In	In	Reflex	Transparent
					Lb	Lb
11	1	1	3 ³ / ₄	5 ¹ / ₄	8	10
12		2	4 ³ / ₄	6 ¹ / ₄	9	14
13		3	5 ³ / ₄	7 ¹ / ₄	11	17
14		4	6 ³ / ₄	8 ¹ / ₄	12	19
15		5	7 ⁷ / ₈	9 ³ / ₈	14	21
16		6	9 ¹ / ₈	10 ⁵ / ₈	16	24
17		7	10 ¹ / ₄	11 ³ / ₄	18	27
18		8	11 ⁷ / ₈	13 ³ / ₈	20	30
19		9	12 ⁵ / ₈	14 ¹ / ₈	21	32
23		2	3	13	14 ¹ / ₂	22
24	4		15	16 ¹ / ₂	25	38
25	5		17 ¹ / ₄	18 ³ / ₄	28	43
26	6		19 ³ / ₄	21 ¹ / ₄	32	49
27	7		22	23 ¹ / ₂	35	54
28	8		25 ¹ / ₄	26 ³ / ₄	40	61
29	9		26 ³ / ₄	28 ¹ / ₄	43	64
36	3		6	30 ³ / ₈	31 ⁷ / ₈	48
37		7	33 ³ / ₄	35 ¹ / ₄	53	80
38		8	38 ⁵ / ₈	40 ¹ / ₈	60	92
39		9	40 ⁷ / ₈	42 ³ / ₈	64	97
47	4	7	45 ¹ / ₂	47	71	107
48		8	52	53 ¹ / ₂	80	122
49		9	55	56 ¹ / ₂	85	129
57	5	7	57 ¹ / ₄	58 ³ / ₄	88	134
58		8	65 ⁵ / ₈	66 ⁷ / ₈	100	152
59		9	69 ⁵ / ₈	70 ³ / ₈	106	161
68	6	8	78 ³ / ₄	80 ¹ / ₄	120	187
69		9	83 ¹ / ₄	84 ³ / ₄	127	196
78	7	8	92 ³ / ₈	93 ⁵ / ₈	140	221
79		9	97 ⁵ / ₈	98 ⁷ / ₈	148	230
88	8	8	105 ¹ / ₂	107	160	254
89		9	111 ¹ / ₂	113	169	265

1.3 Dimensions

Top-Bottom Connections

To obtain maximum gauge length permissible for a **given vessel center-to-center** dimension:

$$\left(\begin{array}{c} \text{Valve} \\ \text{Center-to-Center} \\ \text{Dimension} \end{array} \right) - \left(\begin{array}{c} \text{Dimension} \\ \text{"A"} \end{array} \right)$$

To determine **overall length of nipples** needed to make up a gauge set for a **given vessel center-to-center** dimension:

$$\left(\begin{array}{c} \text{Valve} \\ \text{Center-to-Center} \\ \text{Dimension} \end{array} \right) - \left(\begin{array}{c} \text{Overall} \\ \text{Length} \end{array} + \begin{array}{c} \text{Dimension} \\ \text{"B"} \end{array} \right)$$

Side-Side Connections

To obtain vessel center-to-center dimension for a **given gauge length** with valves offset toward the gauge center:

$$\left(\begin{array}{c} \text{Overall} \\ \text{Length} \end{array} \right) - \left(\begin{array}{c} \text{Dimension} \\ \text{"C"} \end{array} \right)$$

To obtain vessel center-to-center dimension for a **given gauge length** with valves offset away from the gauge center:

$$\left(\begin{array}{c} \text{Overall} \\ \text{Length} \end{array} \right) + \left(\begin{array}{c} \text{Dimension} \\ \text{"C"} \end{array} \right)$$

Overall nipple length can be divided between nipples to suit the application. Minimum length required for each nipple is 1 7/8" for 1/2" NPT nipple and 1 3/8" for 3/4" NPT nipple.

Model	Dim. "A"		Dim. "B"		Dim. "C"	
	1/2" NPT	3/4" NPT	1/2" NPT	3/4" NPT	1/2" NPT	3/4" NPT
3500	2 7/8"	3 1/8"	5/8"	7/8"	1 1/2"	1 7/8"
3510	6 1/8"	6 3/8"	3 7/8"	4 1/8"		

Model 3520/3540

Installation, Operation, and Maintenance Instructions

2.0 INSTALLATION

2.1 Assembly

Before installing the gauge you should always inspect all components for damage incurred in shipping. Notify the shipping company immediately of any damage, and request damage inspection.

Confirm that the following meet application specifications: gauge and model number, pressure / temperature ratings, material compatible with the process fluid and the surrounding atmosphere.

CAUTION: As defined by ASME Section VIII, Mallard Gauge Glasses are NOT to be used for gaging lethal substances.

CONSIDER THE FOLLOWING BEFORE INSTALLING THE GAUGE

- To avoid piping strains on the gauge chamber, connect and mount the gauge so that it does not support any piping.
- Differential thermal expansions between the vessel and the gauge can cause severe mechanical loads on the gauge – especially if the vessel contains cryogenic or hot liquids. To prevent this, install an expansion loop between the gauge and the vessel or use a reasonably longer run of piping.
- Use of support brackets should be considered for gauges over four feet in length or weighing over 100 pounds, especially when the gauge is exposed to vibration. Support brackets will prevent overloading the connecting valves and piping and prevent gauge damage from excessive vibration.
- Always provide shutoff valves between gauges and vessels.
- Bolt torque is extremely important to the proper operation of a liquid level gauge. Because gaskets compress over a period of time, bolt torque should be checked before the gauge is installed. (Ref. To maintenance). Bolt torque should also be checked after the first few hours of operation.

CAUTION: Gauges should always be isolated from the process system by closing upper and lower valves, and draining gauge to relieve pressure before doing any torque or maintenance checks.

3.0 OPERATION

3.1 Theory of Operation

CAUTION: Rapid opening of connecting valves can cause glass breakage and / or possible injury to personnel. Gauges should be brought into service slowly.

Always warm up the gauge slowly when it is used with a vessel containing hot fluids. Crack open the shutoff valves slowly and carefully, and wait until the gauge is fully warmed before opening them all the way. Mallard gauges are fitted with tempered glass that can withstand sharp thermal transitions – cold water to 500° F – without breaking; but additional loads that you cannot measure are imposed on glass during installation, and resistance to thermal shock is reduced correspondingly.

During any system shutdown, it is best to leave the shutoff valves open, the gauge can then cool and depressurize along with the system.

Keeping valves closed during a shutdown can cause high pressure liquid to be trapped in the gauge.

A viewing system of mirrors should be used to protect personnel from possible glass breakage, when high pressure and / or temperature applications are used.

Periodically gauges should be *isolated* and bolt torque checked to prevent leaks. This is especially important on gauges used in intermittent operation or varying service conditions.

Always check for leaks when putting a gauge into service and be certain the shutoff valves are fully open and all vents and drains closed before leaving the site.

CAUTION: While the gauge glass is in operation, the shutoff valves must be in the fully open position. A partially open valve will prevent automatic ball checks from seating which could result in loss of product, and / or physical injury to personnel.

4.0 MAINTENANCE

4.1 Preventive Maintenance

- **Inspection of Glass:**

Look at the glass regularly for any signs of clouding or scratching. In new processes, the glasses should be inspected daily until the need for replacement becomes necessary; establishing a routine inspection cycle.

To examine for scratches, shine a very bright concentrated light (powerful flashlight) at about 45° angle. Anything that glistens brightly should be looked at closely. Any scratch that glistens and catches fingernail, any star-shaped or crescent-shaped mark is cause for replacement. If inner (chemical) surface appears cloudy or roughened and will not respond to cleaning procedures, this is evidence of chemical attack and, if severe, is cause for replacement.

- **Cleaning of Glass:**

Keep glasses clean using commercial glass cleaners (Windex, Glass Wax, Bon-Ami, Lava Soap, Super Soilex, household detergents). Where regular cleaners do not seem to work, it is possible to use dilute acids such as Hydrochloric (muriatic) acid. Observe safety rules carefully when handling any dangerous chemicals. Cleaning should be done *without removing glasses*; this may require recirculation of cleaning material if vessel side of glass is not accessible. Never use harsh abrasives, wire brushes, metal scrapers, or any other things that could scratch the glass. DO NOT attempt to clean glasses while equipment is in operation.

- **Receiving and Storing Glass:**

Inspect containers and glass inserts for shipping damage. Keep glasses in original boxes until ready for use. If contents need to be inspected, unwrap and rewrap carefully, avoid bumping or sliding polished face across any other object (including table tops).

- **Disassembly:**

Prior to any disassembly of the gauge, first be sure that the gauge is relieved of all pressure, and temperature is ambient, *Failure to do this may result in a sudden release of pressure and / or glass breakage*. Loosen end bolts, working from opposite ends toward the center.

- **Reassembly:**

Glass, Gaskets, and Cushions should not be reused, even when they appear in perfect condition. Replace them with new ones. Chipped or scratched glass should not be used, because such defects become points of high stress concentration. Even though a used glass may look perfect, it is not as reliable as a new one. The best practice is to always use a new glass.

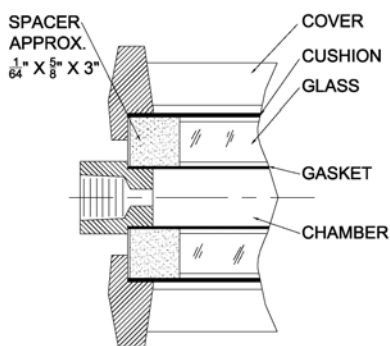
- A. The glass should be seated on a flat surface with a suitable gasket on the seating surface to avoid subjecting the glass to stress concentrations which result from prior loading. It should be clamped in place with a flat cover plate that is uniformly loaded, as described in reassembly procedures below.
- B. The glass should not be in contact with any metal surfaces; in service, temperature differences at points of contact will set up high loadings and may break the glass.
- C. Use gaskets as follows:
1/32 inch thick sheet
- D. For transparent gauges used in steam service – protect the glass from steam erosion by inserting mica sheet between glass and gasket on the liquid side.
- E. Before reassembly, clean gauge chamber seats thoroughly with a soft metal scraper (preferably brass). Be sure all burrs and bits of old gasket are removed, since they cause low gasket compression and leakage.
- F. Locate the glass centrally in the seat and cover, to avoid glass-metal contact at the ends or sides. This is best done with gauge horizontal on a bench. If it must be reassembled in a vertical position, use a small strip of gasket material as a spacer at each end of the glass; the sketch shows how. This will prevent any contact of the glass with metal during assembly and in service.

Model 3520/3540

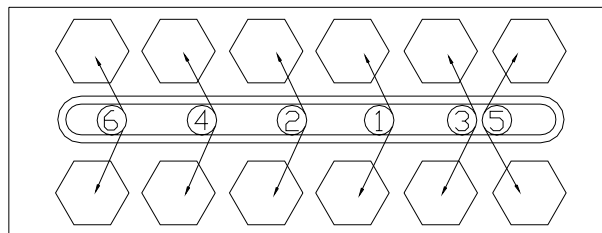
Installation, Operation, and Maintenance Instructions

- G. Replace the gauge covers as follows:
1. Clean bolt and nut threads and apply light oil to threads and the nut face. For gauges operating at more than 150°F, use Molykote or a similar molybdenum disulfide lubricant.
 2. Tighten nuts finger-tight in the sequence shown in the sketch, and then tighten with torque wrench in the same sequence, in five-pound stages; this procedure produces even loading of the glass.

CAUTION: While tightening the cover, be sure the gauge is isolated from the vessel. Close valves between the pressure vessel and the gauge glass and open the vent or drain on the gauge glass to relieve the pressure.



Glass End-Spacer Installation



Sequence for Tightening Cover Bolts

3. Recommended final torques are:

Factory Assembled Gauges at Initial Installation

R & T – 3520 (sizes 3,6,7,8,9)	23 Ft. Lbs.
R & T – 3520 (sizes 1,2,4,5)	32 Ft. Lbs.
R & T – 3540	80 Ft. Lbs.

Field Reassembled Gauges

R & T – 3520 (sizes 3,6,7,8,9)	32 Ft. Lbs.
R & T – 3520 (sizes 1,2,4,5)	32 Ft. Lbs.
R & T – 3540	80 Ft. Lbs.

4. New rubber-bonded gaskets tend to become permanently compressed after a short time in service, especially if the gauge operates hot; this causes slight leaks or apparent loosening of bolts. Therefore, re-torque to the original value after the gauge has been in hot operation for at least half an hour, using the same torque sequence as before.
5. The recommended torque values in paragraph 3 are based on the use of molybdenum disulfide lubricant and the use of rubber bonded asbestos gaskets cut to 3 appropriate dimensions for the particular gauge.
6. Be sure that the replacement glass is appropriate for the service. Check safety devices for operation below pressure rating of the glass.