inferno MANUFACTURING CORPORATION

Level Gage and Gage Valve
Materials of Construction, Typical

Drawing:	M191980
Sheet:	1 of 7
Date:	16-May-2019
Revision:	7
Revision Date:	20-Nov-2019

Group 1 Materials: "Standard" Carbon Steel, NACE Wetted… MDMT -20°F

Ordering examples: ***R100-47 ABNAABCAA with FT15 gage valves***

T100-36 AANAABCAA with FT25 gage valves

Item	Wetted Part	Raw Mat'l Form	Material	Condition	Specification
Gage chamber	yes	bar	carbon steel	quench & tempered; hardness < 22 HRC	ASTM A420 WPL6
Cover flange	no	casting	carbon steel	normalized	ASTM A216 Gr WCC
Bolt	no	fabricated	alloy steel	quench & tempered	ASTM A193 Gr B7
Nut	no	fabricated	carbon steel	quench & tempered	ASTM A194 Gr 2H
Glass	yes	molded	borosilicate glass	tempered (thermally toughened)	DIN 7081
Seal gasket	yes	sheet	flexible graphite with SS insert (Garlock Graph-Lock 3125 SS)		
Cushion gasket	no	sheet	non-asbestos synthetic fiber with NBR binder (Klingersil C4401)		
Valve Body	yes	forging	carbon steel	normalized	ASTM A105
Bonnet	no	casting	CF3 (T304 SS)	solution annealed; hardness < 22 HRC	ASTM A351
Trim	yes	bar	T316 SS	solution annealed; hardness < 22 HRC	ASTM A479
Vessel and/or Gage connector alt 1	yes	bar	carbon steel	normalized	ASTM A696, ASTM A420 WPL6
Vessel and/or Gage connector alt 2	yes	forging	carbon steel	normalized or quench & tempered	ASTM A105
Union nut	no	cold forging	carbon steel	stress relieved	ASTM A105
Bonnet nut	no	cold forging	carbon steel	stress relieved	ASTM A105
Stem Packing	yes		TFE	operating to 500°F	
Union Seal	yes		Viton O-Ring (std)	range: -15°F to 400°F	
Connecting nipple	yes	seamless pipe	carbon steel	per Standard	ASTM A106 Gr B

OPTIONAL MATERIALS

See Note 7

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Group 2 Materials: "Low Temp" Carbon Steel, NACE wetted… MDMT -50°F

Ordering examples: ***R100-47 ABNXXBCAA with FT15-LT gage valves (FT15-LT-LS for long stem option)***

T100-36 AANXXBCAA with FT25-LT gage valves (FT25-LT-LS for long stem option)

Item	Wetted Part	Raw Mat'l Form	Material	Condition	Specification
Gage chamber	yes	bar	carbon steel	quench & tempered; hardness < 22 HRC	ASTM A420 WPL6
Cover flange	no	casting	carbon steel	quench & tempered	ASTM A352 Gr LCC
may substitute		*casting*	*316 SS*	*solution annealed*	*ASTM A351 Gr CF8M*
Bolt	no	fabricated	alloy steel	quench & tempered	ASTM A193 Gr B7
Nut	no	fabricated	carbon steel	quench & tempered	ASTM A194 Gr 2H
Glass	yes	molded	borosilicate glass	tempered (thermally toughened)	DIN 7081
Seal gasket	yes	sheet	flexible graphite with SS insert (Garlock Graph-Lock 3125 SS)		
Cushion gasket	no	sheet	non-asbestos synthetic fiber with NBR binder (Klingersil C4401)		
Valve Body	yes	forging	carbon steel	quench & tempered; hardness < 22 HRC	ASTM A350 LF2
Bonnet	no	casting	CF3 (T304 SS)	solution annealed; hardness < 22 HRC	ASTM A351
Trim	yes	bar	T316 SS	solution annealed; hardness < 22 HRC	ASTM A479
Vessel and/or Gage connector alt 1	yes	bar	carbon steel	normalized with Charpy test @ -50°F	ASTM A696, ASTM A420 WPL6
Vessel and/or Gage connector alt 2	yes	forging	carbon steel	normalized or quench & tempered	ASTM A350 LF2
Union nut	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Bonnet nut	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Stem Packing	yes		TFE	operating to 500°F	
Union Seal	yes		Low Temp Nitrile	range: -55°F to 250°F…. Higher limt available with HSN, see Note 7	
Connecting nipple	yes	seamless pipe	304 or 316SS	solution annealed	ASTM A312

OPTIONAL MATERIALS

See Note 7

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Group 3 Materials: All Stainless Steel, NACE wetted… MDMT -320°F

Ordering examples: ***R100-47 ABNEEBCEA with FT15-SS gage valves (FT15-SS-LS for long stem option)***
T100-36 AANEEBCEA with FT25-SS gage valves (FT25-SS-LS for long stem option)

Item	Wetted Part	Raw Mat'l Form	Material	Condition	Specification
Gage chamber	yes	bar	316 SS	annealed & cold drawn; hardness < 22 HRC	ASTM A479
Cover flange	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Bolt	no	fabricated	316 SS	strain hardened	ASTM A193 Gr B8M Cl2*
Nut	no	fabricated	316 SS	strain hardened	ASTM A194 Gr 8 or Gr 8M*
Glass	yes	molded	borosilicate glass	tempered (thermally toughened)	DIN 7081
Seal gasket	yes	sheet	flexible graphite with SS insert (Garlock Graph-Lock 3125 SS)		
Cushion gasket	no	sheet	non-asbestos synthetic fiber with NBR binder (Klingersil C4401)		
Valve body	yes	forging	316 SS	solution annealed; hardness < 22 HRC	ASTM A182
Bonnet	no	casting	CF3 (T304L SS)	solution annealed; hardness < 22 HRC	ASTM A351 Gr CF3
Trim	yes	bar	T316 SS	solution annealed; hardness < 22 HRC	ASTM A479
Vessel and/or Gage connector	yes	bar	316 SS	solution annealed; hardness < 22 HRC	ASTM A479
Union nut	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Bonnet nut	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Stem Packing	yes		TFE	operating to 500°F	
Union Seal	yes		TFE	range: -250°F to 450°F	
Connecting nipple	yes	seamless pipe	316 SS	solution annealed	ASTM A312

** B8M bolting causes a 15% pressure de-rating (round down to nearest 5)*

OPTIONAL MATERIALS

See Note 7

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Group 4 Materials: "Standard" Carbon Steel, Wetted & Non-Wetted Parts per NACE… MDMT -20°F

Ordering examples: ***R100-47 ABNAABCCA with FT15 gage valves***

T100-36 AANAABCCA with FT25 gage valves

Item	Wetted Part	Raw Mat'l Form	Material	Condition	Specification
Gage chamber	yes	bar	carbon steel	quench & tempered; hardness < 22 HRC	ASTM A420 WPL6
Cover flange	no	casting	carbon steel	normalized	ASTM A216 Gr WCC
Bolt	no	fabricated	alloy steel	quench & tempered	ASTM A193 Gr B7M*
Nut	no	fabricated	carbon steel	quench & tempered	ASTM A194 Gr 2HM*
Glass	yes	molded	borosilicate glass	tempered (thermally toughened)	DIN 7081
Seal gasket	yes	sheet	flexible graphite with SS insert (Garlock Graph-Lock 3125 SS)		
Cushion gasket	no	sheet	non-asbestos synthetic fiber with NBR binder (Klingersil C4401)		
Valve Body	yes	forging	carbon steel	normalized	ASTM A105
Bonnet	no	casting	CF3 (T304 SS)	solution annealed; hardness < 22 HRC	ASTM A351
Trim	yes	bar	T316 SS	solution annealed; hardness < 22 HRC	ASTM A479
Vessel and/or Gage connector alt 1	yes	bar	carbon steel	normalized	ASTM A696, ASTM A420 WPL6
Vessel and/or Gage connector alt 2	yes	forging	carbon steel	normalized or quench & tempered	ASTM A105
Union nut and Bonnet Nut alt 1	no	cold forging	carbon steel	stress relieved	ASTM A105
Union nut and Bonnet Nut alt 2	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Stem Packing	yes		TFE	operating to 500°F	
Union Seal	yes		Viton O-Ring (std)	range: -15°F to 400°F	
Connecting nipple	yes	seamless pipe	carbon steel	per Standard	ASTM A106 Gr B

** B7M bolting causes a 20% pressure de-rating (round down to nearest 5)*

OPTIONAL MATERIALS

See Note 7

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Group 5 Materials: Stainless Steel Wetted Only, NACE wetted… MDMT -20°F

Ordering examples: ***R100-47 ABNEABCAA with FT15-SS gage valves***

T100-36 AANEABCAA with FT25-SS gage valves

Item	Wetted Part	Raw Mat'l Form	Material	Condition	Specification
Gage chamber	yes	bar	316 SS	annealed & cold drawn; hardness < 22 HRC	ASTM A479
Cover flange	no	casting	carbon steel	normalized	ASTM A216 Gr WCC
Bolt	no	fabricated	alloy steel	quench & tempered	ASTM A193 Gr B7
Nut	no	fabricated	carbon steel	quench & tempered	ASTM A194 Gr 2H
Glass	yes	molded	borosilicate glass	tempered (thermally toughened)	DIN 7081
Seal gasket	yes	sheet	flexible graphite with SS insert (Garlock Graph-Lock 3125 SS)		
Cushion gasket	no	sheet	non-asbestos synthetic fiber with NBR binder (Klingersil C4401)		
Valve body	yes	forging	316 SS	solution annealed; hardness < 22 HRC	ASTM A182
Bonnet	no	casting	CF3 (T304L SS)	solution annealed; hardness < 22 HRC	ASTM A351 Gr CF3
Trim	yes	bar	T316 SS	solution annealed; hardness < 22 HRC	ASTM A479
Vessel and/or Gage connector	yes	bar	316 SS	solution annealed; hardness < 22 HRC	ASTM A479
Union nut	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Bonnet nut	no	casting	316 SS	solution annealed	ASTM A351 Gr CF8M
Stem Packing	yes		TFE	operating to 500°F	
Union Seal	yes		TFE	range: -250°F to 450°F	
Connecting nipple	yes	seamless pipe	316 SS	solution annealed	ASTM A312

OPTIONAL MATERIALS

See Note 7

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Notes:

1. Cold Ambient conditions

* LG's holding water subject to freezing weather must be insulated or heat traced to prevent ice formation from damaging seal gaskets. WARNING- freezing water will extrude seals and require re-building. Avoid allowing standing water to freeze in level gage during winter conditions.

2. Cold Process applications

* Non-Frost extensions recommended for cold process; not shown above
* Extended valve stem available to provide clearance for insulation under handwheel. Designate model number as FT15-LS (example)

3. High Temperature limitations

** New versions of Inferno R100, T100, T200 catalog cut sheets now show non-steam pressure ratings to 572°F instead of 600°F. Inferno's previous publications showing 600°F limit was based on satisfactory history & consistent with other published industry ratings. However our glass supplier recommends 572°F (300°C) maximum upper limit for operation therefore we have lowered our maxiumum recommended temperature rating as well. The de-rating is made based on supplier advice; not because of temperature related problems in the field.*

It is to be noted that temperature experienced by the glass pane, installed in the Level Gage does not normally translate to the same temperature as the fluid of the vessel itself. The glass panes in the LG are remote from the fluid in vessel to the extent of the connecting piping where cooling by ambient air may occur. Generally there is no warming flow through the LG because of the static operating nature. Exceptions are during blow-down when vessel operating fluid may flow through the LG.

Gage glass used in Inferno LG's conforms and exceeds the standard DIN 7081 limit of 536°F, as reported by glass supplier. Our suppplier recommends that the glass may be used at full pressure ratings up to 572°F without loss of strength due to high temperature "stress relieving". In addition, Level Gages may be used in non-steam applications at 600°F, such as thermal transfer (hot oil) systems, provided that operating pressure is limited to 145 PSI (10 bar), as provided by the DIN standard "Explanatory Notes".

4. Thermal Shock

* During cooling or warming, the rate of temperature change should not exceed 73˚F (23˚C) per minute, otherwise excessive thermal stresses can cause glass breakage.

5. Steam Service Applications

* In steam service, R100 is rated to 250 WSP; T100/T200 with protective mica shield is rated to 450 WSP. T100/T200 without mica protection is rated same as reflex, to 250 WSP. Exposure of unprotected glass to hot water in excess of these limits causes chemical and structural breakdown and consequent loss of strength, eventually causing leaks and glass breakage.

6. Standard Factory Finish (carbon steel parts):

Component	Standard Finish	Expedited or Alt. Finish
Gage chamber	zinc electroplate- yellow	Krylon spray paint for fast turn-arounds and gage sizes longer than 96"
Cover flange	powder paint- red	
Cap Screw	zinc electroplate- yellow	
U-Bolt	mechanical zink plate- silver	
Nut	zinc electroplate- yellow	
Valve Body	2 part epoxy- grey	
Vessel and/or Gage connector	2 part epoxy- grey	phosphatize only, or Krylon
Union nut	2 part epoxy- grey	
Bonnet nut	2 part epoxy- grey	

7. OPTIONAL MATERIALS	**Wetted Part**	**Material**	**Temperature Range**
Valve Stem Packing	yes	Grafoil	operating to 572°F (limited by glass)
Valve Union Seal, Alternate	yes	TFE	range: -250°F to 450°F
Valve Union Seal, Alternate	yes	HSN Highly Saturated Nitrile (HNBR)	range: -55°F to 300°F
Valve Union Seal, Alternate	yes	Low Temp Nitrile	range: -65°F to 250°F
Valve Union Seal, Alternate	yes	Aflas	range: -15°F to 450°F
Valve Union Seal, Alternate	yes	Kalrez 6375	range: -4°F to 527°F
Valve Union Seal, Alternate	yes	other Kalrez compounds	operating to 572°F (limited by glass)

8. History of Revision

Revision #	Date	Description
7	11/20/2019	Clarified Union nut and Bonnet nut alternates for Group 4