KOMAX SYSTEMS·INC
MIXING BY DESIGN

Vendor Data Book

JOHNSON CONTROLS, INC.

Johnson Controls
INGENUITY WELCOME

""GLCX" GAS-LIQUID CONTACTOR

PO#: 4500403252
Model#: GLC-55789, GLC-55790, GLC-55791
Komax Job#: 25086-09

January 2010

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KOMAX SYSTEMS·INC
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Data Book Contents

“GLCX” GAS-LIQUID CONTACTOR

PO#: 4500403252
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Komax Job#: 25086-09

January 2010

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SECTION 01

APPROVED O&M DRAWING

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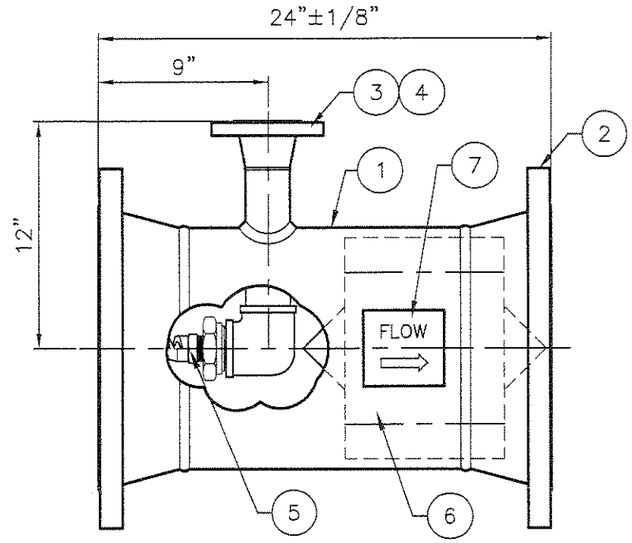

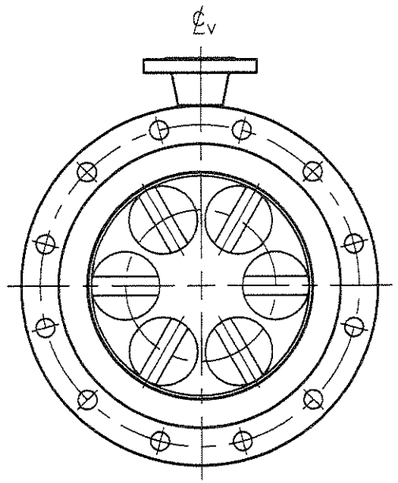

RIGHT SIDE VIEW

1st STAGE SUCTION DESUPERHEATER

NOTES: 1

1. MWP: 200 PSIG
2. MWT: -20/250°F
3. HYDROTEST: 300 PSIG PER ASME B31.3 WITH REPORTS REQUIRED.
4. UNITS TO BE BUILT PER ASME B31.3
5. MATERIAL TEST REPORTS REQUIRED.
6. UNITS TO BE PREPARED FOR SHIPMENT PER MSB-1 REV. H AS APPLICABLE. LOADING WITH NITROGEN AND PRESSURE GAUGE AND HARDWARE INCLUDED.
7. NO MATERIALS FROM CHINA, INDIA, PHILIPPINES & MEXICO.

UNLESS OTHERWISE NOTED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:

1 PLACE DECIMAL± .030"
2 PLACE DECIMAL± .015"
3 PLACE DECIMAL± .005"
FRACTIONAL± 1/16" ANGULAR± 1/2°

KOMAX "GLCX" GAS-LIQUID CONTACTOR

LIST OF MATERIALS

ITEM NO.	QTY.	KOMAX PART NO.	DESCRIPTIONS	MATERIAL / REMARKS
1	1	---	HOUSING, 12 INCH DIAMETER SCHEDULE 40 PIPE	C.S.
2	1	---	FLANGES, 12"-150# RFWN, SCH 40 BORE	A105 C.S.
3	1	---	SIDEPORT, 2 INCH DIAMETER SCHEDULE 40 PIPE	C.S.
4	1	---	FLANGE, 2"-150# RFWN, SCH 40 BORE	A105 C.S.
5	1	CAPACITY SIZE 340	SPRAY NOZZLE, 1" NPT (SPRAYING SYSTEMS CO.)	S.S.
6	1	---	KOMAX EQUALIZER MODULE (HP-30)	C.S.
7	1	---	NAMEPLATE ASSEMBLY	C.S./S.S.
8	A/R	---	PAINT, RUST INHIBITIVE RED OXIDE PRIMER	---

MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING U.S. PATENTS
3201813 3923288, 4034965, 4208136, 4614440, 4808007, 5066137, 5176448, 5484203, 5758967, 5947597, 6024842, 6027241, 6082713, 6102561, 6132079, 6276823
OTHER U.S. AND FOREIGN PATENTS PENDING

KOMAX® SYSTEMS, INC.
P.O. BOX 1323 WILMINGTON, CA 90748-1323 310-830-4320 FAX: 310-830-9826

OUTLINE & MOUNTING CONFIGURATION

KOMAX MODEL NO. GLC-55789

SCALE: 1/8" = 1"	APPROVED BY: LN	DRAWN BY: DP
DATE: 04-20-09		REV. DATE: 07-01-09

CUSTOMER:	QUOTE NO.: 53994-09	CODE#	DRAWING NUMBER:
JOHNSON CONTROLS, INC.	JOB NO.: 25086-09	015	33687

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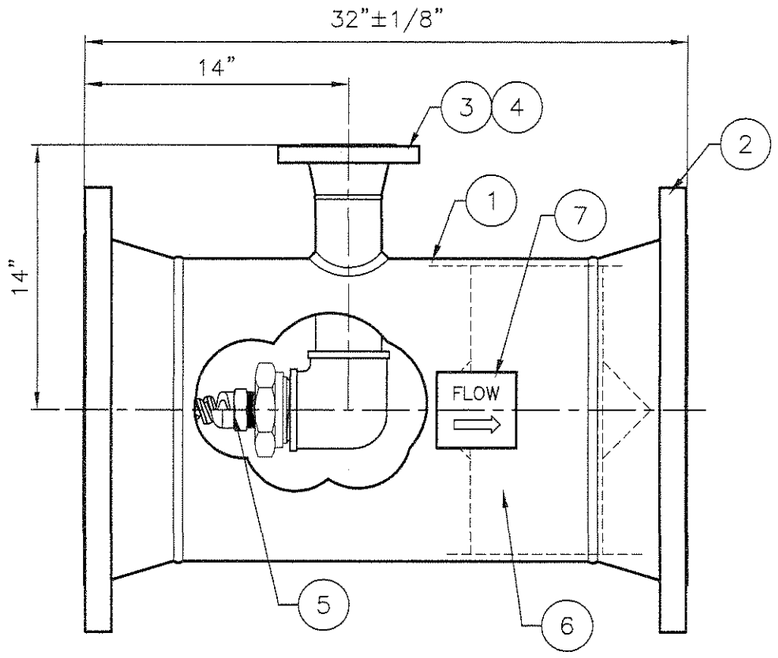

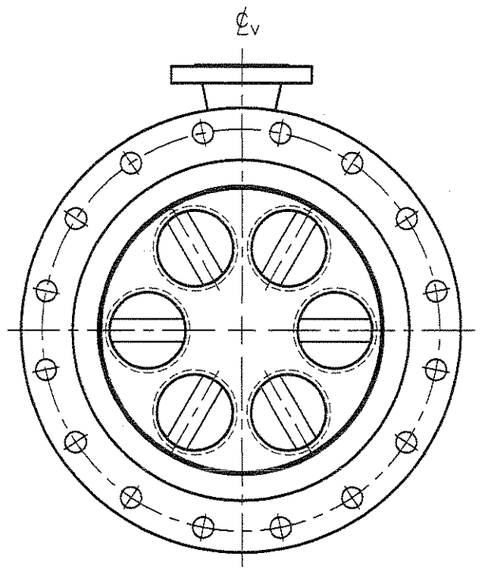

RIGHT SIDE VIEW

2nd STAGE SUCTION DESUPERHEATER

NOTES: 1

1. MWP: 200 PSIG
2. MWT: -20/250°F
3. HYDROTEST: 300 PSIG PER ASME B31.3 WITH REPORTS REQUIRED.
4. UNITS TO BE BUILT PER ASME B31.3
5. MATERIAL TEST REPORTS REQUIRED.
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2 PLACE DECIMAL± .015"
3 PLACE DECIMAL± .005"
FRACTIONAL± 1/16" ANGULAR± 1/2°

KOMAX "GLCX" GAS-LIQUID CONTACTOR

LIST OF MATERIALS

ITEM NO.	QTY.	KOMAX PART NO.	DESCRIPTIONS	MATERIAL / REMARKS
1	1	---	HOUSING, 16 INCH DIAMETER SCHEDULE STD (3/8"THK) PIPE	C.S.
2	2	---	FLANGES, 16"-150# RFWN, SCH STD BORE	A105 C.S.
3	1	---	SIDEPORT, 3 INCH DIAMETER SCHEDULE 40 PIPE	C.S.
4	1	---	FLANGE, 3"-150# RFWN, SCH 40 BORE	A105 C.S.
5	1	CAPACITY SIZE 820	SPRAY NOZZLE, 1 1/2" NPT (SPRAYING SYSTEMS, CO.)	S.S.
6	1	---	KOMAX EQUALIZER MODULE ASSEMBLY (HP-30)	C.S.
7	1	---	NAMEPLATE ASSEMBLY	C.S./S.S.
8	A/R	---	PAINT, RUST INHIBITIVE RED OXIDE PRIMER	---

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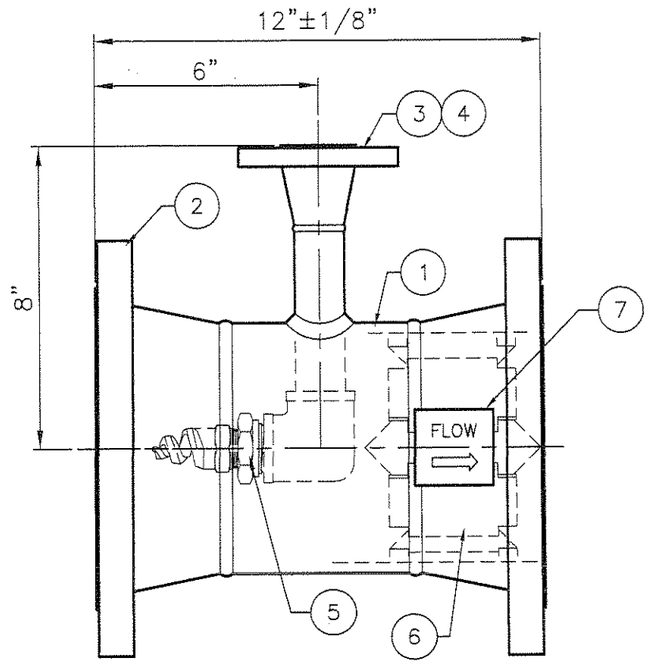
KOMAX® SYSTEMS, INC.
P.O. BOX 1323 WILMINGTON, CA 90748-1323 310-830-4320 FAX: 310-830-9826

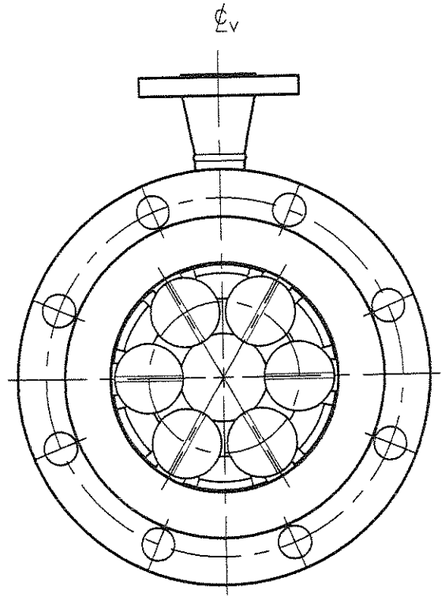
OUTLINE & MOUNTING CONFIGURATION

KOMAX MODEL NO. GLC-55790

SCALE: 1/8" = 1"	APPROVED BY:		DRAWN BY: DP
DATE: 04-20-09	LN		REV. DATE: 07-01-09

CUSTOMER:	QUOTE NO.: 53994-09	CODE#	DRAWING NUMBER:
JOHNSON CONTROLS	JOB NO.: 25086-09	015	33688





RIGHT SIDE VIEW

3RD STAGE SUCTION DESUPERHEATER

REVISION BLOCK				
REV. NO.	DATE	DESCRIPTION	DRAWN	APPR.
1	05-18-09	PER CUSTOMER'S REQUEST	DP	LN
2	06-19-09	PER CUSTOMER'S REQUEST	DP	LN
3	07-01-09	PER CUSTOMER'S REQUEST	DP	LN

NOTES: 3

1. MWP: 200 PSIG
2. MWT: -20/250°F
3. HYDROTEST: 300 PSIG PER ASME B31.3 WITH REPORTS REQUIRED.
4. UNITS TO BE BUILT PER ASME B31.3
5. MATERIAL TEST REPORTS REQUIRED.
6. UNITS TO BE PREPARED FOR SHIPMENT PER MSB-1 REV. H AS APPLICABLE. LOADING WITH NITROGEN AND PRESSURE GAUGE AND HARDWARE INCLUDED.
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3 PLACE DECIMAL± .005"
FRACTIONAL± 1/16" ANGULAR± 1/2°

KOMAX "GLCX" GAS-LIQUID CONTACTOR

LIST OF MATERIALS

ITEM NO.	QTY.	KOMAX PART NO.	DESCRIPTIONS	MATERIAL / REMARKS
1	1	---	HOUSING, 6 INCH DIAMETER SCHEDULE 40 SEAMLESS PIPE	A106 B C.S.
2	2	---	FLANGES, 6"-150# RFWN, SCH 40 BORE	A105 C.S.
3	1	---	SIDEPORT, 1 INCH DIAMETER SCHEDULE 40 SEAMLESS PIPE	A106 B C.S.
4	1	---	FLANGE, 1"-150# RFWN SCH 40 BORE	A105 C.S.
5	1	CAPACITY SIZE 210 1	SPRAY NOZZLE, 3/4" NPT (SPRAYING SYSTEMS, CO.)	S.S.
6	1	---	KOMAX EQUALIZER MODULE	T316S.S.
7	1	---	NAMEPLATE ASSEMBLY	C.S./S.S.
8	A/R	---	PAINT, RUST INHIBITIVE RED OXIDE PRIMER	---

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OTHER U.S. AND FOREIGN PATENTS PENDING

KOMAX® SYSTEMS, INC.
P.O. BOX 1323 WILMINGTON, CA 90748-1323 310-830-4320 FAX: 310-830-9826

OUTLINE & MOUNTING CONFIGURATION

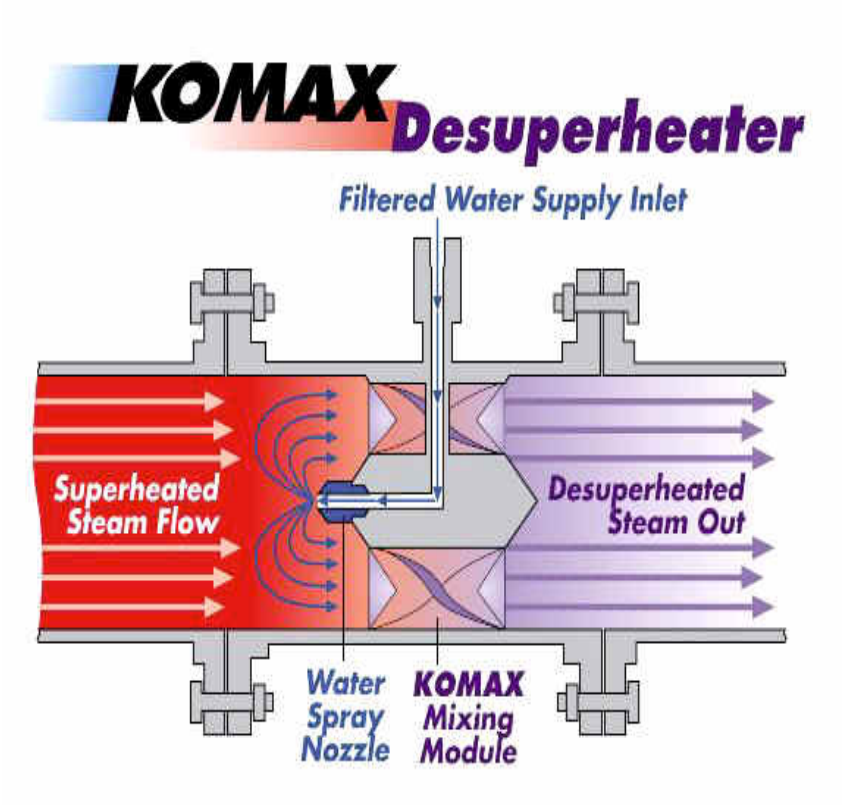
KOMAX MODEL NO. GLC-55791

SCALE: 1/4" = 1"	APPROVED BY: LN	DRAWN BY: DP
DATE: 04-20-09		REV. DATE: 07-01-09
CUSTOMER: JOHNSON CONTROLS	QUOTE NO.: 53994-09 JOB NO.: 25086-09	CODE# 015
		DRAWING NUMBER: 33689

SECTION 02

OPERATION & MAINTENANCE MANUAL

OPERATION, INSTALLATION, AND MAINTENANCE INSTRUCTIONS FOR KOMAX DESUPERHEATER ™	KOMAX SYSTEMS·INC MIXING BY DESIGN APPLICATION BULLETIN NO. DS01



KOMAX SYSTEMS, INC.
P.O. Box 1323
Wilmington, CA 90748

Phone: (310) 830-4320
(800) 826-0760
Fax: (310) 830-9826

Info@komax.com
www.komax.com

WARNING notices as used in this manual apply to hazards or unsafe practices, which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in minor personal injury or property damage.

NOTES highlight procedures and contain information which assists the operator in understanding the information contained in this manual.

WARNING

Do not install, maintain, or operate this equipment without reading, understanding and following the proper Komax Systems, Inc. instructions. Otherwise, injury or damage or both may result.

NOTICE

The information contained in this document is subject to change without notice.

KOMAX Systems, Inc., its employees, agents, and the authors of and contributors to this document specifically disclaim all liabilities and warranties, express and implied (including warranties of merchantability and fitness for a particular purpose), for the accuracy, currency, completeness, and/or reliability of the information contained herein and/or for the fitness for any particular use and/or for the performance of any material and/or equipment selected in whole or part with the user of/or in reliance upon information contained herein. Selection of materials and/or equipment is at the sole risk of the user of this publication.

Komax Systems, Inc.
P.O. Box 1323
Wilmington, CA 90748

Phone: (310) 830-4230
Fax: (310) 830-9826

Normal business hours: 7:00 a.m. to 4:00 p.m. PST Monday through Friday

Safety Precautions

Please read the entire manual before attempting to unpack, set up or operate this product. Pay careful attention to all warnings, cautions and notes. Failure to do so could result in serious personal injury or equipment damage.

Use of Hazard Information

If multiple hazards exist, the signal word corresponding to the greatest hazard shall be used.

Indicates an imminently hazardous situation, which if not avoided, will result in death or serious injury.

Indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

Indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury.

CAUTION used without the safety alert symbol indicates a potentially hazardous situation, which if not avoided, may result in property damage.

NOTE: Information that requires special emphasis

SHALL: This word understood to be mandatory

SHOULD: This word understood to be advisory

⚠WARNING

It is solely the responsibility of the user, through its own analysis and testing, to select products suitable for their specific application requirements, ensure they are properly installed, ensure that they are safely applied, ensure they are properly maintained, and limit their use to their intended purpose.

Improper selection, installation, or use can cause personal injury or property damage.

Komax does not warrant against erosion and corrosion. Komax makes no claims regarding suitability for specific use, and provides no warrantee regarding material compatibility of elastomers in specific services.

⚠WARNING

Hot Surfaces! This equipment may have very hot surfaces. If an operator contacts a hot surface, injury may occur. Use protective clothing to prevent injury. If other equipment comes in contact with a hot surface, damage to the equipment may occur. Ensure the area around this equipment is kept clear to prevent damage from occurring.

⚠WARNING

High Pressures! This equipment may contain fluids at very high pressures. Prior to installing, removing or maintaining this equipment, ensure that the equipment is isolated from all connecting piping, the equipment is de-pressurized, the contents have been drained and the equipment is cool.

⚠WARNING

Freezing Temperatures! This equipment may have very cold surfaces. If an operator contacts a cold surface, injury may occur. Use protective clothing to prevent injury. If other equipment comes in contact with a cold surface, damage to the equipment may occur. Ensure the area around this equipment is kept clear to prevent this damage from occurring.

⚠CAUTION

Freezing of fluids in this equipment can lead to rupture and failure. Take precautions to avoid freezing, such as draining the equipment when out of service or locating the equipment in an environment protected from temperatures below the freeze point of the fluids used.

⚠CAUTION

Cavitation can cause damage and failure of the equipment. Cavitation results whenever localized boiling occurs on the surface of a coil. Vapor bubbles form on the coil surface and are swept into the main stream of the fluid where they immediately condense and collapse. The collapsing bubbles generate severe shock waves (i.e. vibrations) which can fatigue and ultimately fracture the tube(s).

⚠CAUTION

Incompatible fluid chemistry can cause corrosion and/or erosion and eventual failure of this equipment. Corrosion and failure can also occur when the equipment is installed in an environment incompatible with the materials of construction of this equipment. It is the responsibility of the Owner or the Owner's Agent to ensure the materials of construction of the equipment are suitable for the fluid chemistry and environment where the equipment is to be used.

⚠CAUTION

Water containing carbonates, rust, silt, organic matter or other contaminants can cause fouling, scaling and/or plugging and eventual failure of the equipment.

⚠WARNING

To ensure the safety of the operator and the performance of this equipment is not impaired, this equipment must not be installed or used in any manner other than that which is specified in this manual.

⚠WARNING

Prior to installing, removing or maintaining this equipment, ensure that the equipment is isolated from all connecting piping, the equipment is de-pressurized, the contents have been drained and the equipment is cool.

⚠WARNING

Damage to the equipment may occur if a relief valve is omitted.

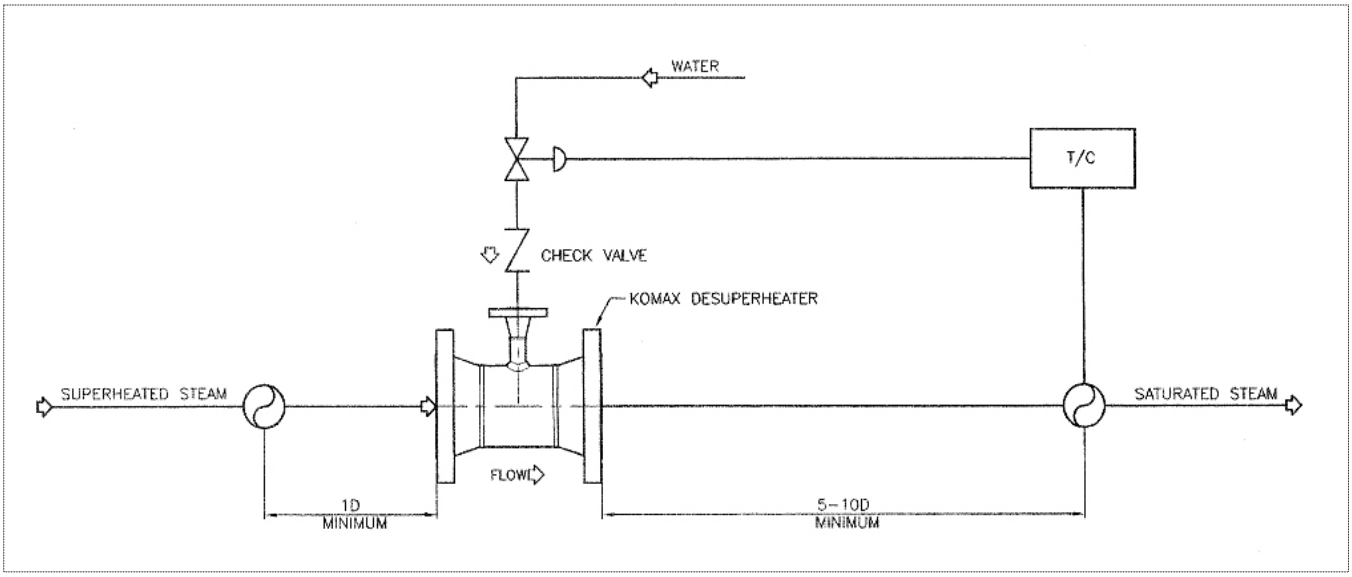
Desuperheating

Steam is usually produced in a superheated condition for distribution to equipment. A good example of such equipment would be a tube and shell heat exchanger. For the high heat transfer coefficient of a condensing vapor to be made available, most of this superheat must now be removed - hence the need for desuperheating.

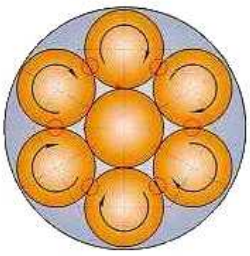
The most direct and efficient way to desuperheat steam is by water contact with the steam. This contact must occur in a short length so that a temperature-sensing device placed downstream of the desuperheater will reflect the true condition of the steam when all the enthalpy of the water has been exchanged to reduce the steam temperature.

The contacting process involves two considerations. First, the water must be broken up into many tiny droplets. An appropriate design of spray nozzle is usually used. Second, these tiny water droplets must be contacted with the steam over the entire cross section of the main steam pipe cross section.

Many conventional desuperheaters employ a nozzle that sprays water downstream in the steam pipe. The high steam velocity tends to fold and coalesce the water spray droplets, and this reduces contacting efficiency. Special techniques using ancillary inputs of steam or air to the nozzle can produce a stiffer spray pattern, but erosion problems can now develop due to the high velocity of wet steam.



Komax desuperheaters are unique because a spray nozzle directs a water spray upstream into the steam flow. The steam flow reduces the axial velocity of the spray to zero and then reverses as it flows with the steam through a special mixing unit called an Equalizer. This patented module consists of six helical mixing elements nested about the axis of the structure. The combination of steam and water mist is split 12 ways and caused to exit the Equalizer in the form of six streams, each rotating violently in the same direction. This produces multiple impingement regions at the immediate exit of the module. Contacting and mixing of water mist and steam occur in a very short mixing length, and flow of excess water into the condensate trap is reduced.



Steam / Water Impingement

Rangability

The design of the water nozzle is key to achieving good rangability characteristics for the overall desuperheating system. The pressure applied to the nozzle must be higher than the steam pressure by some amount dP. A simple fixed nozzle has a flow rate Q versus pressure drop dP given by:

$$\mathbf{Q = a\ constant\ x\ (dP)^{0.5}}$$

This means that if the pressure applied to the nozzle changes by a factor of 10, the flow through the nozzle only increases by a factor of 3.2. Clearly, this is highly restrictive to the goal of achieving good rangability.

The Komax desuperheater does not rely solely on the initial atomization of the injected water to evaporate it into the superheated flow. We instead design the system to assure uniform dispersion and moderate atomization in a counter flow direction. The cone-shaped water spray is then reversed by the steam's momentum and driven through our equalizer module mixing apparatus. This is where the droplet size is minimized and then collided with superheated steam. As a result of this approach, low pressure water delivery systems may be used reducing cost and energy consumption. We generally require a 30psi differential in the water pressure over the steam. The low pressure nozzle is not prone to scaling or wear and as a result delivers exceptionally long consistent performance.

Rangability of the Komax desuperheater is limited only by the level of control possible in the water supply control loop. We do require a minimum of 50 ft/sec in the steam flow at actual conditions to assure good dispersion and mass transfer. This parameter can be further optimized with specific installation / process specifications.

Pressure Drop

Pressure drop in a Komax desuperheater is estimated by:

$$\mathbf{dP = 8.32 \times 10^{-4} M^2 / psia D^4\ psi}$$

where
M = stem flow rate in lb/hr
psia = absolute operating pressure
D = pipe inside diameter in inches

Example:

Steam pressure = 50 psig = 65psia
Steam flow rate = 3,500 lb/hr
Pipe size = 8 inches

Then pressure drop = $0.00082 \times 3500^2/65 \times 8^4 = 0.03$psi

Water Flow Rate Requirements

The water flow rate required for a given reduction of superheat may be calculated from:

$$Q = 0.002M_s(E_1 - E_2) / (E_2 - E_w) \text{ gpm}$$

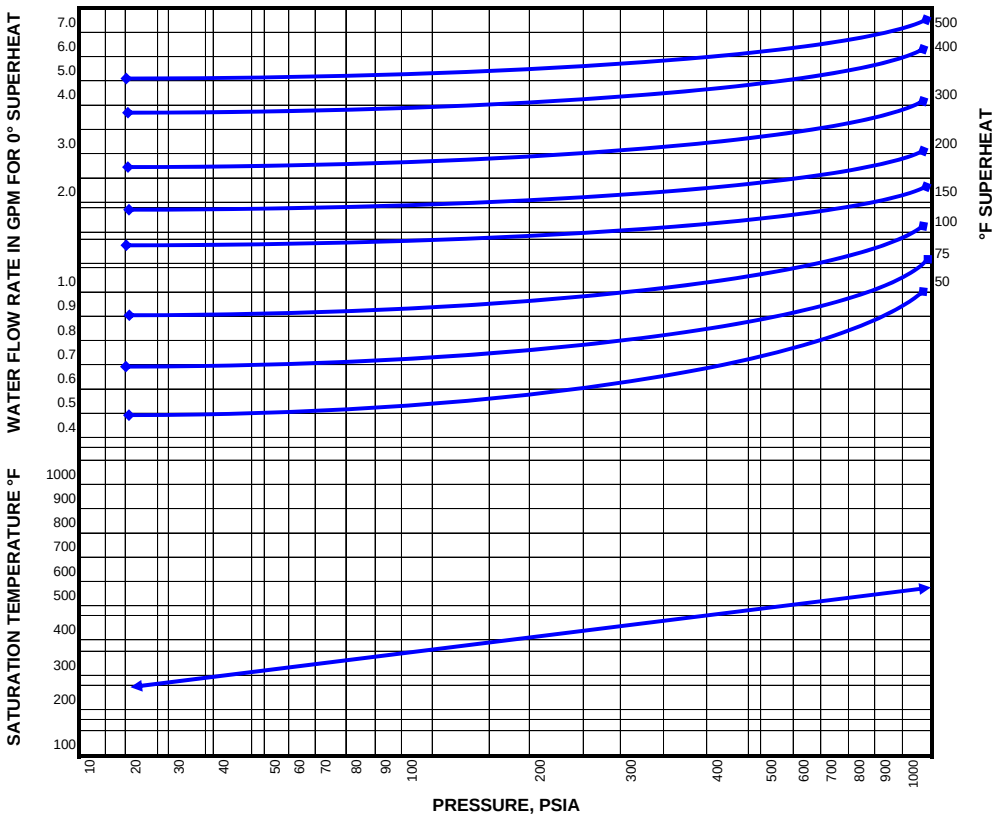
where

M_s = Steam flow rate in pounds per hour
E_1 = Enthalpy of superheated steam in BTU/pound
E_2 = Enthalpy of desuperheated steam
E_w = Enthalpy of added water

The graph below can simplify calculations. It is based on a steam flow rate of 10,000 lb/hr and a water temperature of 70°F.

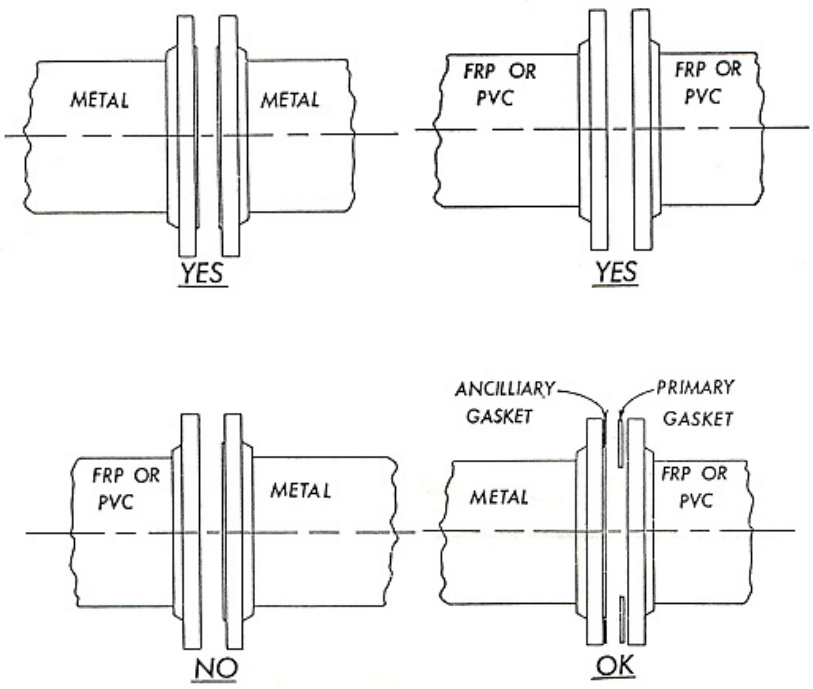
Example: Steam enters at a flow rate of 25,000 lb/hr, a temperature of 600°F, and a pressure of 235psig - 250psia. What is the superheat and what is the water flow rate required to reduce the superheat to zero?

Enter at the steam pressure value of 250psia and move up to the graph line and identify the saturation temperature as 400°F. Then superheat = 600 - 400 = 200°F. Move up to the 200° superheat curve and read the water flow rate as 2.8gpm for 10,000 lb/hr of steam. Then water flow rate required for 25,000 lb/hr = 2.5 x 2.8 = 5.6gpm.

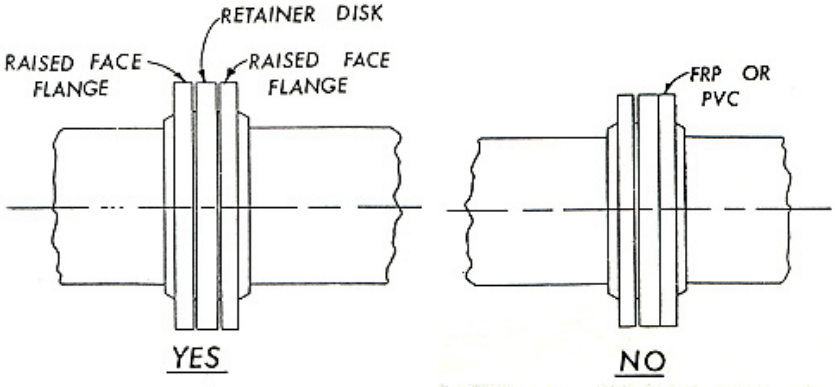


Notes On Flanges

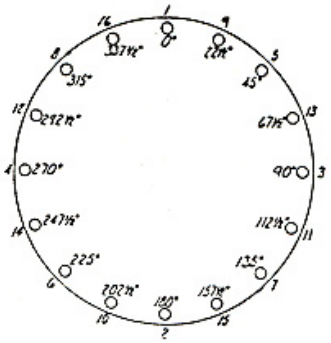
As a general rule, metal mixers have raised face flanges. P.V.C. mixers and FRP mixers on the other hand have flat face flanges. It is poor engineering practice to bolt a raised face flange directly to a flat face flange since dangerous stresses will be placed on the flat face. If, however, installation conditions dictate the joining of a flat to a raised face flange, an appropriate washer must be used to eliminate the stress produced by the raised face.



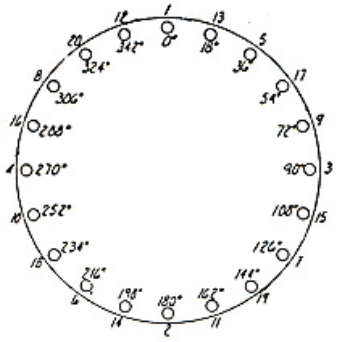
Note that units configured with a pair of element retainer disks are treated as raised face units. Although the retainer disk is flat, the flange to flange forces are from the spool raised face to mating flange raised face.



Torque Procedure



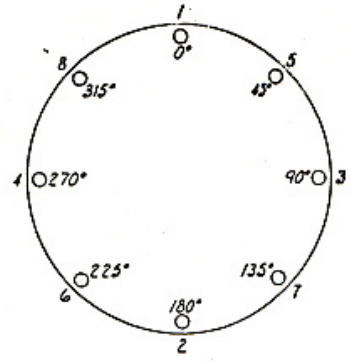
16-BOLTS



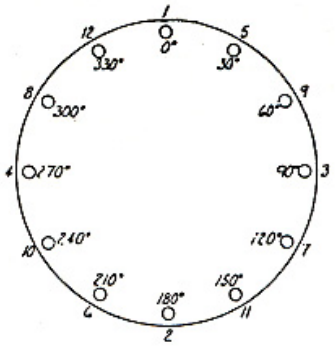
20-BOLTS

TORQUE SEQUENCE FOR 16 BOLT FLANGES		TORQUE SEQUENCE FOR 20 BOLT FLANGES	
SEQUENTIAL ORDER	**ROTATIONAL ORDER**	**SEQUENTIAL ORDER**	**ROTATIONAL ORDER**
1-2	1	1-2	1
3-4	9	3-4	13
5-6	5	5-6	5
7-8	13	7-8	17
9-10	3	9-10	9
11-12	11	11-12	3
13-14	7	13-14	15
15-16	15	15-16	7
	2	17-18	19
	10	19-20	11
	6		2
	14		14
	4		6
	12		18
	8		10
	16		4
			16
			8
			20
			12

Torque Procedure



8-BOLTS



12-BOLTS

TORQUE SEQUENCE FOR 8 BOLT FLANGES		TORQUE SEQUENCE FOR 12 BOLT FLANGES	
SEQUENTIAL ORDER	**ROTATIONAL ORDER**	**SEQUENTIAL ORDER**	**ROTATIONAL ORDER**
1-2	1	1-2	1
3-4	5	3-4	5
5-6	3	5-6	9
7-8	7	7-8	3
	2	9-10	7
	6	11-12	11
	4		2
	8		6
			10
			4
			8
			12

Installation

Please see the Komax certified engineering drawings for dimensions, installation details and marking for each Komax desuperheater by Serial No./Tag No., which supersede these general instructions.

Main steam system piping

1. Minimum straight pipe downstream: The Komax desuperheater requires a minimum of 10 pipe diameters of straight pipe from the valve installation to the first bend downstream

2. Minimum straight pipe upstream: The Komax desuperheater requires a minimum of 3 diameters of straight pipe upstream

3. Avoid using “T” fittings between the desuperheater and the downstream temperature sensor.

4. Minimum distance to the downstream temperature sensor is 3 pipe diameter.

5. The temperature sensor should be mounted in accordance with manufacturer's recommendation. The sensor should not be mounted in an elbow or pipe bend.

6. Desuperheater applications requiring multiple desuperheaters in the same steam line should split range the instrument signal with the downstream desuperheater opening first.

Cooling water supply and connection

1. The cooling water should be clean, filtered condensate of boiler feed water.

2. Komax recommends that the cooling water line include a shut-off valve and a strainer with .020" [0.5mm] perforation, or equal mesh, sized for the flow rate requirements.

3. The water pressure at the inlet to the desuperheater should be per the Komax certified Outline & Mounting Configuration drawing.

4. The water flange connection has a specific orientation to the direction of water spray. The water spray direction must be in the same direction as the steam flow.

Water Line Connection

Clean and flush the cooling water line prior to connecting to the desuperheater water flange. Connect the water line to the flange.

Operating Controls

The desuperheating station instrument control loop should include an indicating temperature controller, a temperature transmitter, temperature sensor, and temperature thermo well.

If steam pressure varies significantly and reducing temperature down close to saturation is important then a self-compensating cascade pressure loop can be added to vary the temperature set point to assure control close to saturation temperature.

Maintenance

Review the Komax certified installation drawing, which gives the sizing and conditions specified for the desuperheating valve.

The desuperheater's ability to maintain temperature control over its range of temperature and pressure is proof of proper performance. Clean desuperheating fluid, specified pressures and proper packing gland adjustment will assure long life.

Yearly checks of performance should be evaluated. Komax recommends a maintenance inspection every three years.

Operational Evaluation

1. The desuperheater should run trouble free, excluding control component failure or mis-adjustment.

2. Review the current operation conditions: pressure, temperatures and flows and compare to those specified on the certified sizing sheet.

3. Defer to controls interaction for control system debugging.

Ordering Parts

There is a Komax data plate located on the desuperheater body. Please provide the Komax model number when ordering parts. Control system components should be sourced from their respective manufacturers. On hand for routine inspection – Stem packing set, stem guide bushing, stem/piston ring assembly, seal, and gasket.

Spare nozzle: 1 on hand
Gaskets: 1 set on hand

Unpacking, Preparation and Storage

Upon receipt of the valve, inspect valve and shipping container for transit damage such as a broken crate, broken yoke, bent valve stem or broken accessories. Check: documentation, nameplate, tag plate (if applicable), instruction manuals… etc. Locate any spare parts purchased and included in the shipment.

Use the shipping container for temporary protection. Leave protective covers in place until ready to proceed with inspection and installation. Store the valve in a clean, dry location. If outdoor storage is unavoidable, support the valve off the ground or pavement and provide a waterproof covering.

Lift the valve by means of straps around valve body and inlet flange. **Do Not** use the actuator as the sole location to attach lifting straps.

Long Term Storage

Use a dry heated inside storage area. Remove the valve stem packing. Make sure valve is dry and free from moisture. Apply cosmoline-type protective grease to the flange face, packing stuffing box and valve stem.

Preparation for Installation

Remove all paper, tape and packing materials, and all foreign materials. Transport carefully to the installation site. Remove valve protective covers and install the valve in the system.

KOMAX SYSTEMS·INC
MIXING BY DESIGN

SECTION 03
B31.3 CALCULATIONS

ITEM: KOMAX MODEL NO. GLC-55789, 12" FLANGED PIPE SPOOL

CODE: ASME B31.3-2006

JOB NO: 25086-09

CUSTOMER: JOHNSON CONTROLS, INC.

REFERENCE: KOMAX DRAWING 33687

DESCRIPTION:

12" NPS FLANGED PIPE SPOOL ASSEMBLY PER DETAILS SHOWN ON REFERENCE DRAWINGS. THE SPOOL ASSEMBLY CONSISTS OF A 12" NPS SCH 40 RUN PIPE W/ASME B16.5 CLASS 150 RFWN FLANGE AT EACH END, & A 2" NPS SCH 40 BRANCH PIPE W/ASME B16.5 CLASS 150 RFWN FLANGE.

DESIGN DATA

INTERNAL PRESSURE RATING =	$MAWP := 200 \cdot psi$		$MAWP = 1379\ kPa$
HYDROSTATIC HEAD =	INCLUDED IN MAWP		
INTERNAL DESIGN PRESSURE =	$P := MAWP$	$P = 200\ psi$	$P = 1379\ kPa$
EXTERNAL PRESSURE RATING =	$P_{EXT} := 0 \cdot psi$		
DESIGN TEMPERATURE =	$T := 250 \cdot degF$		$T = 121\ degC$
MIN DESIGN METAL TEMP =	$MDMT := -20 \cdot degF$		$MDMT = -29\ degC$
SERVICE:	NON-LEATHAL NORMAL FLUID		
EXTERNAL LOADS:	NONE OR NEGLIGIBLE		
THERMAL LOADS:	NONE OR NEGLIGIBLE		
CYCLIC LOADS:	NONE OR NEGLIGIBLE		
CORROSION ALLOWANCES =	$c := 0.0625 \cdot in$		$c = 1.6\ mm$
MATERIALS: [TBL A-1]	PIPE: ASTM A-106 Gr B SEAMLESS FLANGES: ASTM A-105, ASME B16.5 ALL ABOVE ARE P-1 MATERIALS PER TBL A-1		
POSTWELD HEAT TREATMENT:	NONE, EXEMPT PER TABLE 331.1.1 FOR P-1 MATERIALS NOT EXCEEDING 3/4" THICKNESS		
IMPACT TESTS:	NONE. MATERIALS ARE EXEMPT FROM ADDITION IMPACT TESTS PER TABLES A-1 & 323.2.2, BASED UPON THICKNESS & MDMT.		
NDE:	VISUAL EXAMINATION PER 341.4.1(a) & IN-PROCESS 344.2 VISUAL EXAMINATION OF ALL WELDS PER 344.7.1. NO UT OR RT REQ'D (SEE 341.4.1(b))		

REQUIRED WALL THICKNESS OF RUN PIPE [304.1]

PIPE = 12" NPS SCH 40 PIPE MATERIAL = ASTM A-106 Gr B SMLS PIPE

PIPE OD = $D_r := 12.75 \cdot in$ $D_r = 324\,mm$

CORROSION ALLOWANCE = $c = 0.0625\,in$ $c = 1.6\,mm$

DESIGN PRESSURE = $P = 200\,psi$ $P = 1379\,kPa$

CODE ALLOWABLE STRESSES PER TBL A-1: $S_{rd} := 20000 \cdot psi$ @ $T = 250\,degF$

$S_{rd} = 137895\,kPa$ @ $T = 38\,degC$

PIPE NOMINAL WALL THICKNESS = $T_{r\_nom} := 0.406 \cdot in$ $T_{r\_nom} = 10.31\,mm$

PIPE MATERIAL SPECIFICATION ALLOWS 12.5% UNDER-TOLERANCE ON NOMINAL WALL THICKNESS.

PIPE MINIMUM WALL THICKNESS = $T_r := 0.875 \cdot T_{r\_nom}$ $T_r = 0.355\,in$ $T_r = 9.02\,mm$

LONGITUDINAL JOINT QUALITY FACTOR = $E_{jr} := 1.00$ [PER TBL A-1B]

WELD JOINT STRENGTH REDUCTION FACTOR = $W_r := 1.00$ [302.3.6(e)]

$Y_r := 0.4$ [TBL 304.1.1] $\frac{D_r}{6} = 2.125\,in > T_r = 0.355\,in$ $\frac{D_r}{6} = 54\,mm > T_r = 9.02\,mm$

REQUIRED THICKNESS FOR INTERNAL PRESSURE PER 304.1.2 = $t_r := \frac{P \cdot D_r}{2 \cdot \left(S_{rd} \cdot E_{jr} \cdot W_r + P \cdot Y_r\right)}$ $t_r = 0.063\,in$ $t_r = 1.61\,mm$

$t_r + c = 0.126\,in < T_r = 0.355\,in$ ***OK***

$t_r + c = 3.2\,mm < T_r = 9.02\,mm$ ***OK***

ALLOWABLE PRESSURE = $P_{allow} := \frac{2 \cdot \left(T_r - c\right) \cdot \left(S_{rd} \cdot E_{jr} \cdot W_r + P \cdot Y_r\right)}{D_r}$

$P_{allow} = 922\,psi > P = 200\,psi$

$P_{allow} = 6358\,kPa > P = 1379\,kPa$

THE SPECIFIED PIPE IS ADEQUATE FOR THE INTERNAL DESIGN PRESSURE.

REQUIRED WALL THICKNESS OF BRANCH PIPE [304.1]

PIPE = 2" NPS SCH 40 PIPE MATERIAL = ASTM A-106 Gr B SMLS PIPE

PIPE OD = $D_b := 2.375 \cdot in$ $D_b = 60\,mm$

CORROSION ALLOWANCE = $c = 0.0625\,in$ $c = 1.6\,mm$

DESIGN PRESSURE = $P = 200\,psi$ $P = 1379\,kPa$

CODE ALLOWABLE STRESSES PER TBL A-1: $S_{bd} := 20000 \cdot psi$ @ $T = 250\,degF$

$S_{bd} = 137895\,kPa$ @ $T = 38\,degC$

PIPE NOMINAL WALL THICKNESS = $T_{b\_nom} := 0.154 \cdot in$ $T_{b\_nom} = 3.91\,mm$

PIPE MATERIAL SPECIFICATION ALLOWS 12.5% UNDER-TOLERANCE ON NOMINAL WALL THICKNESS.

PIPE MINIMUM WALL THICKNESS = $T_b := 0.875 \cdot T_{b\_nom}$ $T_b = 0.135\,in$ $T_b = 3.42\,mm$

LONGITUDINAL JOINT QUALITY FACTOR = $E_{jb} := 1.00$ [PER TBL A-1B]

WELD JOINT STRENGTH REDUCTION FACTOR = $W_b := 1.00$ [302.3.5(e)]

$Y_b := 0.4$ [TBL 304.1.1] $\frac{D_b}{6} = 0.396\,in > T_b = 0.135\,in$ $\frac{D_b}{6} = 10.1\,mm > T_b = 3.42\,mm$

REQUIRED THICKNESS FOR INTERNAL PRESSURE PER 304.1.2 = $t_b := \frac{P \cdot D_b}{2 \cdot \left(S_{bd} \cdot E_{jb} \cdot W_b + P \cdot Y_b\right)}$ $t_b = 0.012\,in$ $t_b = 0.30\,mm$

$t_b + c = 0.074\,in < T_b = 0.135\,in$ ***OK***

$t_b + c = 1.89\,mm < T_b = 3.42\,mm$ ***OK***

ALLOWABLE PRESSURE = $P_{allow} := \frac{2 \cdot \left(T_b - c\right) \cdot \left(S_{bd} \cdot E_{jb} \cdot W_b + P \cdot Y_b\right)}{D_b}$

$P_{allow} = 1222\,psi > P = 200\,psi$

$P_{allow} = 8423\,kPa > P = 1379\,kPa$

THE SPECIFIED PIPE IS ADEQUATE FOR THE INTERNAL DESIGN PRESSURE.

ASME B16.5 FLANGE PRESSURE RATING

MATERIAL = ASTM A-105

ALLOWABLE WORKING PRESSURE FOR CLASS 150 FLANGES:

$P_{d\_flg} := 245 \cdot psi$ @ $T = 250\,degF > P = 200\,psi$

$P_{d\_flg} = 1689\,kPa$ @ $T = 38\,degC > P = 1379\,kPa$

CLASS 150 FLANGE PRESSURE RATING EXCEEDS DESIGN PRESSURE. ***OK***

REINFORCEMENT OF RUN PIPE WELDED BRANCH CONNECTION : [304.3.3]

The branch connection is a 2"NPS pipe, insertd through the wall of the seamless run pipe.

	Branch Data	Run/Header Data	Reinforcing Pad
Description:	2"Sch 40 Smls Pipe	12"Sch 40 Smls Pipe	None
Materials:	ASTM A-106 Gr B	ASTM A-106 Gr B	
Tbl A-1 Allowable Stresses:	$S_{bd} = 20000\,psi$	$S_{rd} = 20000\,psi$	$S_p := 0\cdot psi$
	$S_{bd} = 137895\,kPa$	$S_{rd} = 137895\,kPa$	$S_p = 0\,kPa$
OD's:	$D_b = 2.375\,in$	$D_r = 12.75\,in$	$D_p := 0\cdot in$
	$D_b = 60.3\,mm$	$D_r = 323.9\,mm$	$D_p = 0\,mm$
Nominal Thicknesses:	$T_{b\_nom} = 0.154\,in$	$T_{r\_nom} = 0.406\,in$	
	$T_{b\_nom} = 3.9\,mm$	$T_{r\_nom} = 10.3\,mm$	
Minimum Thicknesses:	$T_b = 0.135\,in$	$T_r = 0.355\,in$	$T_p := 0\cdot in$
	$T_b = 3.4\,mm$	$T_r = 9\,mm$	$T_p = 0\,mm$
Height/OD Projection:	$L_b := 3.125\cdot in$		
	$L_b = 79.375\,mm$		
Corrosion Allowances:	$c = 0.063\,in$	$c = 0.063\,in$	
	$c = 1.588\,mm$	$c = 1.588\,mm$	
Weld Joint Quality Factors:	$E_{jb} = 1.0$	$E_{jr} = 1$	
Joint Strength Reduction Factors:	$W_b = 1.0$	$W_r = 1$	
Coefficients:	$Y_b = 0.4$	$Y_r = 0.4$	
Corroded ID:	$d_1 := D_b - 2\cdot(T_b - c)$		
	$d_1 = 2.231\,in$		
	$d_1 = 56.7\,mm$		
Effective Height:	$h_b := L_b$		
Required Thicknesses:	$t_b := \frac{P\cdot d_1}{2\cdot\left[S_{bd}\cdot E_{jb}\cdot W_b - P\cdot(1 - Y_b)\right]}$		
	$t_b = 0.011\,in$	$t_r := \frac{P\cdot D_r}{2\cdot(S_{rd}\cdot E_{jr}\cdot W_r + P\cdot Y_r)}$	
	$t_b = 0.285\,mm$	$t_r = 0.063\,in$ $\quad t_r = 1.613\,mm$	
Attachment Type:	Inserted w/Full Pen Weld		
Branch Angle to Header:	$\alpha := 90\cdot deg$		

REINFORCEMENT OF RUN PIPE WELDED BRANCH CONNECTION Continued

Limits Of Reinforcement:

$0.5d_1 + \left[\left(T_b - c\right) + \left(T_r - c\right)\right] = 1.48\,in$ $\quad 0.5d_1 + \left[\left(T_b - c\right) + \left(T_r - c\right)\right] = 37.6\,mm$

$$d_2 := min\left[\begin{array}{c} max\left[\begin{array}{c} 0.5d_1 + \left(T_b - c\right) + \left(T_r - c\right) \\ d_1 \end{array}\right] \\ D_r \end{array}\right] \qquad d_2 = 2.231\,in \qquad d_2 = 56.655\,mm$$

$$L4 := min\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] \qquad L4 = 0.536\,in \qquad L4 = 13.611\,mm$$

$$\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] = \left(\begin{array}{c} 3.125 \\ 0.732 \\ 0.536 \end{array}\right) in$$

$$\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] = \left(\begin{array}{c} 79.4 \\ 18.6 \\ 13.6 \end{array}\right) mm$$

Strength Reduction Factors: For an Inserted Branch Attachment

$$\frac{S_{bd}\cdot E_{jb}}{S_{rd}\cdot E_{jr}} = 1 \qquad f_{r1} := min\left(\begin{array}{c} 1.0 \\ \frac{S_{bd}\cdot E_{jb}}{S_{rd}\cdot E_{jr}} \end{array}\right) \qquad f_{r1} = 1$$

Area Calculations:

Required Reinforcement Area = $A_1 := t_r\cdot d_1\cdot(2 - sin(\alpha))$ $\quad A_1 = 0.142\,in^2$ $\quad A_1 = 91\,mm^2$

Available Areas: Based upon an inserted nozzle

Header Wall: $A_2 := \left(2\cdot d_1 - d_1\right)\cdot\left(T_r - t_r - c\right)$ $\quad A_2 = 0.511\,in^2$ $\quad A_2 = 330\,mm^2$

Nozzle OD Projection: $A_3 := \frac{2\cdot f_{r1}\cdot\left(T_b - t_b - c\right)}{sin(\alpha)}\cdot min\left(L4, h_b\right)$ $\quad A_3 = 0.065\,in^2$ $\quad A_3 = 42\,mm^2$

Total Area Available For Reinforcement:

$A_A := \left(A_2 + A_3\right)$ $\quad A_A = 0.577\,in^2$ **>** $A_1 = 0.142\,in^2$ **.... OK**

$A_A = 372\,mm^2$ **>** $A_1 = 91\,mm^2$ **.... OK**

The Branch Opening Is Adequately Reinforced

MDMT & IMPACT TEST REQUIREMENTS

MATERIAL MDMT'S PER TABLE A-1:

ASTM A106-B PIPE: PER CURVE B IN FIG 323.2.2A WHICH = -20 degF (-29 degC) FOR THICKNESSES NOT EXCEEDING 1/2".

ASTM A-105 FORGING: -20 degF (-29 degC)

THE LIMITING MDMT PER TABLE A-1 = $MDMT = -20\,degF$

PER TABLE 323.2.2, IMPACT TESTS ARE NOT REQUIRED FOR BASE METALS, WELD METALS, OR HAZ'S, FOR THE ABOVE SPECIFIED MDMT.

HYDROSTATIC TEST: [345.4.2]

ALLOWABLE STRESSES @ DESIGN TEMPERATURE ARE LESS THAN ALLOWABLE STRESSES @ TEST (AMBIENT) TEMPERATURE.

Material	Allowable Stresses At Design Temerature		Allowable Stresses At Test Temp	
ASTM A106 Gr 6	$S_{dp} := 20000 \cdot psi$	$S_{dp} = 137895\,kPa$	$S_{dpa} := 20000 \cdot psi$	$S_{dpa} = 137895\,kPa$
ASTM A105	$S_{df} := 21600 \cdot psi$	$S_{df} = 148926\,kPa$	$S_{dfa} := 23300 \cdot psi$	$S_{dfa} = 160648\,kPa$

Test to Design Stress Ratios $\frac{S_{dpa}}{S_{dp}} = 1$ $\frac{S_{dfa}}{S_{df}} = 1.079$

Minimum Hydrotest pressure = $P_{T\_min} := 1.5 \cdot MAWP \cdot min\left(\frac{S_{dpa}}{S_{dp}}, \frac{S_{dfa}}{S_{df}}\right)$ $P_{T\_min} = 300\,psi$

$P_{T\_min} = 2068\,kPa$

$\frac{P_{T\_min}}{1.5} = 200\,psi$ < $P_{150a} := 285 \cdot psi$ = Flange rating at 100 degF ***OK***

$\frac{P_{T\_min}}{1.5} = 1379\,kPa$ < $P_{150a} = 1965\,kPa$ = Flange rating at 37.8 degC

TEST WITH WATER AT $P_T := P_{T\_min}$ $P_T = 300\,psi$ $P_T = 2068\,kPa$

SOFTWARE VERIFICATION

This calculation was produced using the computer software program MathCAD v.11.2a, (MathSoft, Inc., Cambridge, MA). MathCAD's `Live Document Interface' allows numeric & symbolic calculations, text & graphics to be directly entered and edited anywhere in the document. Variables and constants must be defined prior to use in an mathematical equation. The operator ":=" in mathematical equations defines that the variable or expression on the left is equal to the expression or value on the right. The value to the right of an "=" sign is the mathematically precise value of the variable or expression to the left, including the justification of units. Since there are no hidden formulas in this calculation, the `verification' required of spreadsheet or `canned' computer calculations is not required. The numeric results will be correct if the variables & mathematical expressions are correctly defined.

ITEM: KOMAX MODEL NO. GLC-55790, 16" FLANGED PIPE SPOOL

CODE: ASME B31.3-2006

JOB NO: 25086-09

CUSTOMER: JOHNSON CONTROLS, INC.

REFERENCE: KOMAX DRAWING 33688

DESCRIPTION:

16" NPS FLANGED PIPE SPOOL ASSEMBLY PER DETAILS SHOWN ON REFERENCE DRAWINGS. THE SPOOL ASSEMBLY CONSISTS OF A 16" NPS STD WT RUN PIPE W/ASME B16.5 CLASS 150 RFWN FLANGE AT EACH END, & A 3" NPS SCH 40 BRANCH PIPE W/ASME B16.5 CLASS 150 RFWN FLANGE.

DESIGN DATA

INTERNAL PRESSURE RATING =	$MAWP := 200 \cdot psi$		$MAWP = 1379\ kPa$
HYDROSTATIC HEAD =	INCLUDED IN MAWP		
INTERNAL DESIGN PRESSURE =	$P := MAWP$	$P = 200\ psi$	$P = 1379\ kPa$
EXTERNAL PRESSURE RATING =	$P_{EXT} := 0 \cdot psi$		
DESIGN TEMPERATURE =	$T := 250 \cdot degF$		$T = 121\ degC$
MIN DESIGN METAL TEMP =	$MDMT := -20 \cdot degF$		$MDMT = -29\ degC$
SERVICE:	NON-LEATHAL NORMAL FLUID		
EXTERNAL LOADS:	NONE OR NEGLIGIBLE		
THERMAL LOADS:	NONE OR NEGLIGIBLE		
CYCLIC LOADS:	NONE OR NEGLIGIBLE		
CORROSION ALLOWANCES =	$c := 0.0625 \cdot in$		$c = 1.6\ mm$
MATERIALS: [TBL A-1]	PIPE: ASTM A-106 Gr B SEAMLESS FLANGES: ASTM A-105, ASME B16.5 ALL ABOVE ARE P-1 MATERIALS PER TBL A-1		
POSTWELD HEAT TREATMENT:	NONE, EXEMPT PER TABLE 331.1.1 FOR P-1 MATERIALS NOT EXCEEDING 3/4" THICKNESS		
IMPACT TESTS:	NONE. MATERIALS ARE EXEMPT FROM ADDITION IMPACT TESTS PER TABLES A-1 & 323.2.2, BASED UPON THICKNESS & MDMT.		
NDE:	VISUAL EXAMINATION PER 341.4.1(a) & IN-PROCESS 344.2 VISUAL EXAMINATION OF ALL WELDS PER 344.7.1. NO UT OR RT REQ'D (SEE 341.4.1(b))		

REQUIRED WALL THICKNESS OF RUN PIPE [304.1]

PIPE = 16" NPS STD WT PIPE MATERIAL = ASTM A-106 Gr B SMLS PIPE

PIPE OD = $D_r := 16.0 \cdot in$ $D_r = 406\,mm$

CORROSION ALLOWANCE = $c = 0.0625\,in$ $c = 1.6\,mm$

DESIGN PRESSURE = $P = 200\,psi$ $P = 1379\,kPa$

CODE ALLOWABLE STRESSES PER TBL A-1: $S_{rd} := 20000 \cdot psi$ @ $T = 250\,degF$

$S_{rd} = 137895\,kPa$ @ $T = 38\,degC$

PIPE NOMINAL WALL THICKNESS = $T_{r\_nom} := 0.375 \cdot in$ $T_{r\_nom} = 9.53\,mm$

PIPE MATERIAL SPECIFICATION ALLOWS 12.5% UNDER-TOLERANCE ON NOMINAL WALL THICKNESS.

PIPE MINIMUM WALL THICKNESS = $T_r := 0.875 \cdot T_{r\_nom}$ $T_r = 0.328\,in$ $T_r = 8.33\,mm$

LONGITUDINAL JOINT QUALITY FACTOR = $E_{jr} := 1.00$ [PER TBL A-1B]

WELD JOINT STRENGTH REDUCTION FACTOR = $W_r := 1.00$ [302.3.6(e)]

$Y_r := 0.4$ [TBL 304.1.1] $\frac{D_r}{6} = 2.667\,in > T_r = 0.328\,in$ $\frac{D_r}{6} = 67.7\,mm > T_r = 8.33\,mm$

REQUIRED THICKNESS FOR INTERNAL PRESSURE PER 304.1.2 = $t_r := \frac{P \cdot D_r}{2 \cdot \left(S_{rd} \cdot E_{jr} \cdot W_r + P \cdot Y_r\right)}$ $t_r = 0.080\,in$ $t_r = 2.02\,mm$

$t_r + c = 0.142\,in < T_r = 0.328\,in$ ***OK***

$t_r + c = 3.61\,mm < T_r = 8.33\,mm$ ***OK***

ALLOWABLE PRESSURE = $P_{allow} := \frac{2 \cdot \left(T_r - c\right) \cdot \left(S_{rd} \cdot E_{jr} \cdot W_r + P \cdot Y_r\right)}{D_r}$

$P_{allow} = 667\,psi > P = 200\,psi$

$P_{allow} = 4597\,kPa > P = 1379\,kPa$

THE SPECIFIED PIPE IS ADEQUATE FOR THE INTERNAL DESIGN PRESSURE.

REQUIRED WALL THICKNESS OF BRANCH PIPE [304.1]

PIPE = 3" NPS SCH 40 PIPE MATERIAL = ASTM A-106 Gr B SMLS PIPE

PIPE OD = $D_b := 3.5 \cdot in$ $D_b = 89\,mm$

CORROSION ALLOWANCE = $c = 0.0625\,in$ $c = 1.6\,mm$

DESIGN PRESSURE = $P = 200\,psi$ $P = 1379\,kPa$

CODE ALLOWABLE STRESSES PER TBL A-1: $S_{bd} := 20000 \cdot psi$ @ $T = 250\,degF$

$S_{bd} = 137895\,kPa$ @ $T = 38\,degC$

PIPE NOMINAL WALL THICKNESS = $T_{b\_nom} := 0.216 \cdot in$ $T_{b\_nom} = 5.49\,mm$

PIPE MATERIAL SPECIFICATION ALLOWS 12.5% UNDER-TOLERANCE ON NOMINAL WALL THICKNESS.

PIPE MINIMUM WALL THICKNESS = $T_b := 0.875 \cdot T_{b\_nom}$ $T_b = 0.189\,in$ $T_b = 4.8\,mm$

LONGITUDINAL JOINT QUALITY FACTOR = $E_{jb} := 1.00$ [PER TBL A-1B]

WELD JOINT STRENGTH REDUCTION FACTOR = $W_b := 1.00$ [302.3.5(e)]

$Y_b := 0.4$ [TBL 304.1.1] $\frac{D_b}{6} = 0.583\,in > T_b = 0.189\,in$ $\frac{D_b}{6} = 14.8\,mm > T_b = 4.8\,mm$

REQUIRED THICKNESS FOR INTERNAL PRESSURE PER 304.1.2 = $t_b := \frac{P \cdot D_b}{2 \cdot \left(S_{bd} \cdot E_{jb} \cdot W_b + P \cdot Y_b\right)}$ $t_b = 0.017\,in$ $t_b = 0.44\,mm$

$t_b + c = 0.080\,in < T_b = 0.189\,in$ ***OK***

$t_b + c = 2.03\,mm < T_b = 4.80\,mm$ ***OK***

ALLOWABLE PRESSURE = $P_{allow} := \frac{2 \cdot \left(T_b - c\right) \cdot \left(S_{bd} \cdot E_{jb} \cdot W_b + P \cdot Y_b\right)}{D_b}$

$P_{allow} = 1451\,psi > P = 200\,psi$

$P_{allow} = 10008\,kPa > P = 1379\,kPa$

THE SPECIFIED PIPE IS ADEQUATE FOR THE INTERNAL DESIGN PRESSURE.

ASME B16.5 FLANGE PRESSURE RATING

MATERIAL = ASTM A-105

ALLOWABLE WORKING PRESSURE FOR CLASS 150 FLANGES:

$P_{d\_flg} := 245 \cdot psi$ @ $T = 250\,degF > P = 200\,psi$

$P_{d\_flg} = 1689\,kPa$ @ $T = 38\,degC > P = 1379\,kPa$

CLASS 150 FLANGE PRESSURE RATING EXCEEDS DESIGN PRESSURE. ***OK***

REINFORCEMENT OF RUN PIPE WELDED BRANCH CONNECTION : [304.3.3]

The branch connection is a 3"NPS pipe, insertd through the wall of the seamless run pipe.

	Branch Data	Run/Header Data	Reinforcing Pad
Description:	3"Sch 40 Smls Pipe	16"Std Wt Smls Pipe	None
Materials:	ASTM A-106 Gr B	ASTM A-106 Gr B	
Tbl A-1 Allowable Stresses:	$S_{bd} = 20000\,psi$	$S_{rd} = 20000\,psi$	$S_p := 0\cdot psi$
	$S_{bd} = 137895\,kPa$	$S_{rd} = 137895\,kPa$	$S_p = 0\,kPa$
OD's:	$D_b = 3.5\,in$	$D_r = 16\,in$	$D_p := 0\cdot in$
	$D_b = 88.9\,mm$	$D_r = 406.4\,mm$	$D_p = 0\,mm$
Nominal Thicknesses:	$T_{b\_nom} = 0.216\,in$	$T_{r\_nom} = 0.375\,in$	
	$T_{b\_nom} = 5.5\,mm$	$T_{r\_nom} = 9.5\,mm$	
Minimum Thicknesses:	$T_b = 0.189\,in$	$T_r = 0.328\,in$	$T_p := 0\cdot in$
	$T_b = 4.8\,mm$	$T_r = 8.3\,mm$	$T_p = 0\,mm$
Height/OD Projection:	$L_b := 3.125\cdot in$		
	$L_b = 79.375\,mm$		
Corrosion Allowances:	$c = 0.063\,in$	$c = 0.063\,in$	
	$c = 1.588\,mm$	$c = 1.588\,mm$	
Weld Joint Quality Factors:	$E_{jb} = 1.0$	$E_{jr} = 1$	
Joint Strength Reduction Factors:	$W_b = 1.0$	$W_r = 1$	
Coefficients:	$Y_b = 0.4$	$Y_r = 0.4$	
Corroded ID:	$d_1 := D_b - 2\cdot(T_b - c)$		
	$d_1 = 3.247\,in$		
	$d_1 = 82.5\,mm$		
Effective Height:	$h_b := L_b$		
Required Thicknesses:	$t_b := \frac{P\cdot d_1}{2\cdot\left[S_{bd}\cdot E_{jb}\cdot W_b - P\cdot(1 - Y_b)\right]}$		
	$t_b = 0.016\,in$	$t_r := \frac{P\cdot D_r}{2\cdot(S_{rd}\cdot E_{jr}\cdot W_r + P\cdot Y_r)}$	
	$t_b = 0.415\,mm$	$t_r = 0.080\,in$ $\quad t_r = 2.024\,mm$	
Attachment Type:	Inserted w/Full Pen Weld		
Branch Angle to Header:	$\alpha := 90\cdot deg$		

REINFORCEMENT OF RUN PIPE WELDED BRANCH CONNECTION Continued

Limits Of Reinforcement:

$0.5d_1 + \left[\left(T_b - c\right) + \left(T_r - c\right)\right] = 2.016\,in$ $\quad 0.5d_1 + \left[\left(T_b - c\right) + \left(T_r - c\right)\right] = 51.2\,mm$

$$d_2 := min\left[\begin{array}{c} max\left[\begin{array}{c} 0.5d_1 + \left(T_b - c\right) + \left(T_r - c\right) \\ d_1 \end{array}\right] \\ D_r \end{array}\right] \qquad d_2 = 3.247\,in \qquad d_2 = 82.474\,mm$$

$$L4 := min\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] \qquad L4 = 0.644\,in \qquad L4 = 16.367\,mm$$

$$\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] = \left(\begin{array}{c} 3.125 \\ 0.664 \\ 0.644 \end{array}\right) in$$

$$\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] = \left(\begin{array}{c} 79.4 \\ 16.9 \\ 16.4 \end{array}\right) mm$$

Strength Reduction Factors: For an Inserted Branch Attachment

$$\frac{S_{bd}\cdot E_{jb}}{S_{rd}\cdot E_{jr}} = 1 \qquad f_{r1} := min\left(\begin{array}{c} 1.0 \\ \frac{S_{bd}\cdot E_{jb}}{S_{rd}\cdot E_{jr}} \end{array}\right) \qquad f_{r1} = 1$$

Area Calculations:

Required Reinforcement Area = $A_1 := t_r\cdot d_1\cdot(2 - sin(\alpha))$ $\quad A_1 = 0.259\,in^2$ $\quad A_1 = 167\,mm^2$

Available Areas: Based upon an inserted nozzle

Header Wall: $A_2 := \left(2\cdot d_1 - d_1\right)\cdot\left(T_r - t_r - c\right)$ $\quad A_2 = 0.604\,in^2$ $\quad A_2 = 390\,mm^2$

Nozzle OD Projection: $A_3 := \frac{2\cdot f_{r1}\cdot\left(T_b - t_b - c\right)}{sin(\alpha)}\cdot min\left(L4, h_b\right)$ $\quad A_3 = 0.142\,in^2$ $\quad A_3 = 92\,mm^2$

Total Area Available For Reinforcement:

$A_A := \left(A_2 + A_3\right)$ $\quad A_A = 0.746\,in^2$ **>** $A_1 = 0.259\,in^2$ **.... OK**

$A_A = 481\,mm^2$ **>** $A_1 = 167\,mm^2$ **.... OK**

The Branch Opening Is Adequately Reinforced

MDMT & IMPACT TEST REQUIREMENTS

MATERIAL MDMT'S PER TABLE A-1:

ASTM A106-B PIPE: PER CURVE B IN FIG 323.2.2A WHICH = -20 degF (-29 degC) FOR THICKNESSES NOT EXCEEDING 1/2".

ASTM A-105 FORGING: -20 degF (-29 degC)

THE LIMITING MDMT PER TABLE A-1 = $MDMT = -20\,degF$

PER TABLE 323.2.2, IMPACT TESTS ARE NOT REQUIRED FOR BASE METALS, WELD METALS, OR HAZ'S, FOR THE ABOVE SPECIFIED MDMT.

HYDROSTATIC TEST: [345.4.2]

ALLOWABLE STRESSES @ DESIGN TEMPERATURE ARE LESS THAN ALLOWABLE STRESSES @ TEST (AMBIENT) TEMPERATURE.

Material	Allowable Stresses At Design Temerature		Allowable Stresses At Test Temp	
ASTM A106 Gr 6	$S_{dp} := 20000 \cdot psi$	$S_{dp} = 137895\,kPa$	$S_{dpa} := 20000 \cdot psi$	$S_{dpa} = 137895\,kPa$
ASTM A105	$S_{df} := 21600 \cdot psi$	$S_{df} = 148926\,kPa$	$S_{dfa} := 23300 \cdot psi$	$S_{dfa} = 160648\,kPa$

Test to Design Stress Ratios $\frac{S_{dpa}}{S_{dp}} = 1$ $\frac{S_{dfa}}{S_{df}} = 1.079$

Minimum Hydrotest pressure = $P_{T\_min} := 1.5 \cdot MAWP \cdot min\left(\frac{S_{dpa}}{S_{dp}}, \frac{S_{dfa}}{S_{df}}\right)$ $P_{T\_min} = 300\,psi$

$P_{T\_min} = 2068\,kPa$

$\frac{P_{T\_min}}{1.5} = 200\,psi$ < $P_{150a} := 285 \cdot psi$ = Flange rating at 100 degF ***OK***

$\frac{P_{T\_min}}{1.5} = 1379\,kPa$ < $P_{150a} = 1965\,kPa$ = Flange rating at 37.8 degC

TEST WITH WATER AT $P_T := P_{T\_min}$ $P_T = 300\,psi$ $P_T = 2068\,kPa$

SOFTWARE VERIFICATION

This calculation was produced using the computer software program MathCAD v.11.2a, (MathSoft, Inc., Cambridge, MA). MathCAD's `Live Document Interface' allows numeric & symbolic calculations, text & graphics to be directly entered and edited anywhere in the document. Variables and constants must be defined prior to use in an mathematical equation. The operator ":=" in mathematical equations defines that the variable or expression on the left is equal to the expression or value on the right. The value to the right of an "=" sign is the mathematically precise value of the variable or expression to the left, including the justification of units. Since there are no hidden formulas in this calculation, the `verification' required of spreadsheet or `canned' computer calculations is not required. The numeric results will be correct if the variables & mathematical expressions are correctly defined.

ITEM: KOMAX MODEL NO. GLC-55791, 6" FLANGED PIPE SPOOL

CODE: ASME B31.3-2006

JOB NO: 25086-09

CUSTOMER: JOHNSON CONTROLS, INC.

REFERENCE: KOMAX DRAWING 33689

DESCRIPTION:

6" NPS FLANGED PIPE SPOOL ASSEMBLY PER DETAILS SHOWN ON REFERENCE DRAWINGS. THE SPOOL ASSEMBLY CONSISTS OF A 6" NPS SCH 40 RUN PIPE W/ASME B16.5 CLASS 150 RFWN FLANGE AT EACH END, & A 1" NPS SCH 40 BRANCH PIPE W/ASME B16.5 CLASS 150 RFWN FLANGE.

DESIGN DATA

INTERNAL PRESSURE RATING =	$MAWP := 200 \cdot psi$		$MAWP = 1379\ kPa$
HYDROSTATIC HEAD =	INCLUDED IN MAWP		
INTERNAL DESIGN PRESSURE =	$P := MAWP$	$P = 200\ psi$	$P = 1379\ kPa$
EXTERNAL PRESSURE RATING =	$P_{EXT} := 0 \cdot psi$		
DESIGN TEMPERATURE =	$T := 250 \cdot degF$		$T = 121\ degC$
MIN DESIGN METAL TEMP =	$MDMT := -20 \cdot degF$		$MDMT = -29\ degC$
SERVICE:	NON-LEATHAL NORMAL FLUID		
EXTERNAL LOADS:	NONE OR NEGLIGIBLE		
THERMAL LOADS:	NONE OR NEGLIGIBLE		
CYCLIC LOADS:	NONE OR NEGLIGIBLE		
CORROSION ALLOWANCES =	$c := 0.0625 \cdot in$		$c = 1.6\ mm$
MATERIALS: [TBL A-1]	PIPE: ASTM A-106 Gr B SEAMLESS FLANGES: ASTM A-105, ASME B16.5 ALL ABOVE ARE P-1 MATERIALS PER TBL A-1		
POSTWELD HEAT TREATMENT:	NONE, EXEMPT PER TABLE 331.1.1 FOR P-1 MATERIALS NOT EXCEEDING 3/4" THICKNESS		
IMPACT TESTS:	NONE. MATERIALS ARE EXEMPT FROM ADDITION IMPACT TESTS PER TABLES A-1 & 323.2.2, BASED UPON THICKNESS & MDMT.		
NDE:	VISUAL EXAMINATION PER 341.4.1(a) & IN-PROCESS 344.2 VISUAL EXAMINATION OF ALL WELDS PER 344.7.1. NO UT OR RT REQ'D (SEE 341.4.1(b))		

REQUIRED WALL THICKNESS OF RUN PIPE [304.1]

PIPE = 6" NPS SCH 40 PIPE MATERIAL = ASTM A-106 Gr B SMLS PIPE

PIPE OD = $D_r := 6.625 \cdot in$ $D_r = 168\,mm$

CORROSION ALLOWANCE = $c = 0.0625\,in$ $c = 1.6\,mm$

DESIGN PRESSURE = $P = 200\,psi$ $P = 1379\,kPa$

CODE ALLOWABLE STRESSES PER TBL A-1: $S_{rd} := 20000 \cdot psi$ @ $T = 250\,degF$

$S_{rd} = 137895\,kPa$ @ $T = 38\,degC$

PIPE NOMINAL WALL THICKNESS = $T_{r\_nom} := 0.280 \cdot in$ $T_{r\_nom} = 7.11\,mm$

PIPE MATERIAL SPECIFICATION ALLOWS 12.5% UNDER-TOLERANCE ON NOMINAL WALL THICKNESS.

PIPE MINIMUM WALL THICKNESS = $T_r := 0.875 \cdot T_{r\_nom}$ $T_r = 0.245\,in$ $T_r = 6.22\,mm$

LONGITUDINAL JOINT QUALITY FACTOR = $E_{jr} := 1.00$ [PER TBL A-1B]

WELD JOINT STRENGTH REDUCTION FACTOR = $W_r := 1.00$ [302.3.6(e)]

$Y_r := 0.4$ [TBL 304.1.1] $\frac{D_r}{6} = 1.104\,in > T_r = 0.245\,in$ $\frac{D_r}{6} = 28\,mm > T_r = 6.22\,mm$

REQUIRED THICKNESS FOR INTERNAL PRESSURE PER 304.1.2 = $t_r := \frac{P \cdot D_r}{2 \cdot \left(S_{rd} \cdot E_{jr} \cdot W_r + P \cdot Y_r\right)}$ $t_r = 0.033\,in$ $t_r = 0.84\,mm$

$t_r + c = 0.095\,in < T_r = 0.245\,in$ ***OK***

$t_r + c = 2.43\,mm < T_r = 6.22\,mm$ ***OK***

ALLOWABLE PRESSURE = $P_{allow} := \frac{2 \cdot \left(T_r - c\right) \cdot \left(S_{rd} \cdot E_{jr} \cdot W_r + P \cdot Y_r\right)}{D_r}$

$P_{allow} = 1106\,psi > P = 200\,psi$

$P_{allow} = 7628\,kPa > P = 1379\,kPa$

THE SPECIFIED PIPE IS ADEQUATE FOR THE INTERNAL DESIGN PRESSURE.

REQUIRED WALL THICKNESS OF BRANCH PIPE [304.1]

PIPE = 1" NPS SCH 40 PIPE MATERIAL = ASTM A-106 Gr B SMLS PIPE

PIPE OD = $D_b := 1.315 \cdot in$ $D_b = 33\,mm$

CORROSION ALLOWANCE = $c = 0.0625\,in$ $c = 1.6\,mm$

DESIGN PRESSURE = $P = 200\,psi$ $P = 1379\,kPa$

CODE ALLOWABLE STRESSES PER TBL A-1: $S_{bd} := 20000 \cdot psi$ @ $T = 250\,degF$

$S_{bd} = 137895\,kPa$ @ $T = 38\,degC$

PIPE NOMINAL WALL THICKNESS = $T_{b\_nom} := 0.133 \cdot in$ $T_{b\_nom} = 3.38\,mm$

PIPE MATERIAL SPECIFICATION ALLOWS 12.5% UNDER-TOLERANCE ON NOMINAL WALL THICKNESS.

PIPE MINIMUM WALL THICKNESS = $T_b := 0.875 \cdot T_{b\_nom}$ $T_b = 0.116\,in$ $T_b = 2.96\,mm$

LONGITUDINAL JOINT QUALITY FACTOR = $E_{jb} := 1.00$ [PER TBL A-1B]

WELD JOINT STRENGTH REDUCTION FACTOR = $W_b := 1.00$ [302.3.5(e)]

$Y_b := 0.4$ [TBL 304.1.1] $\frac{D_b}{6} = 0.219\,in > T_b = 0.116\,in$ $\frac{D_b}{6} = 5.6\,mm > T_b = 2.96\,mm$

REQUIRED THICKNESS FOR INTERNAL PRESSURE PER 304.1.2 = $t_b := \frac{P \cdot D_b}{2 \cdot \left(S_{bd} \cdot E_{jb} \cdot W_b + P \cdot Y_b\right)}$ $t_b = 0.0065\,in$ $t_b = 0.17\,mm$

$t_b + c = 0.069\,in < T_b = 0.116\,in$ ***OK***

$t_b + c = 1.75\,mm < T_b = 2.96\,mm$ ***OK***

ALLOWABLE PRESSURE = $P_{allow} := \frac{2 \cdot \left(T_b - c\right) \cdot \left(S_{bd} \cdot E_{jb} \cdot W_b + P \cdot Y_b\right)}{D_b}$

$P_{allow} = 1645\,psi > P = 200\,psi$

$P_{allow} = 11344\,kPa > P = 1379\,kPa$

THE SPECIFIED PIPE IS ADEQUATE FOR THE INTERNAL DESIGN PRESSURE.

ASME B16.5 FLANGE PRESSURE RATING

MATERIAL = ASTM A-105

ALLOWABLE WORKING PRESSURE FOR CLASS 150 FLANGES:

$P_{d\_flg} := 245 \cdot psi$ @ $T = 250\,degF > P = 200\,psi$

$P_{d\_flg} = 1689\,kPa$ @ $T = 38\,degC > P = 1379\,kPa$

CLASS 150 FLANGE PRESSURE RATING EXCEEDS DESIGN PRESSURE. ***OK***

REINFORCEMENT OF RUN PIPE WELDED BRANCH CONNECTION : [304.3.3]

The branch connection is a 1"NPS pipe, insertd through the wall of the seamless run pipe.

	Branch Data	Run/Header Data	Reinforcing Pad
Description:	1"Sch 40 Smls Pipe	6"Std Wt Smls Pipe	None
Materials:	ASTM A-106 Gr B	ASTM A-106 Gr B	
Tbl A-1 Allowable Stresses:	$S_{bd} = 20000\,psi$	$S_{rd} = 20000\,psi$	$S_p := 0\cdot psi$
	$S_{bd} = 137895\,kPa$	$S_{rd} = 137895\,kPa$	$S_p = 0\,kPa$
OD's:	$D_b = 1.315\,in$	$D_r = 6.625\,in$	$D_p := 0\cdot in$
	$D_b = 33.4\,mm$	$D_r = 168.3\,mm$	$D_p = 0\,mm$
Nominal Thicknesses:	$T_{b\_nom} = 0.133\,in$	$T_{r\_nom} = 0.28\,in$	
	$T_{b\_nom} = 3.4\,mm$	$T_{r\_nom} = 7.1\,mm$	
Minimum Thicknesses:	$T_b = 0.116\,in$	$T_r = 0.245\,in$	$T_p := 0\cdot in$
	$T_b = 3\,mm$	$T_r = 6.2\,mm$	$T_p = 0\,mm$
Height/OD Projection:	$L_b := 3.125\cdot in$		
	$L_b = 79.375\,mm$		
Corrosion Allowances:	$c = 0.063\,in$	$c = 0.063\,in$	
	$c = 1.588\,mm$	$c = 1.588\,mm$	
Weld Joint Quality Factors:	$E_{jb} = 1.0$	$E_{jr} = 1$	
Joint Strength Reduction Factors:	$W_b = 1.0$	$W_r = 1$	
Coefficients:	$Y_b = 0.4$	$Y_r = 0.4$	
Corroded ID:	$d_1 := D_b - 2\cdot(T_b - c)$		
	$d_1 = 1.207\,in$		
	$d_1 = 30.7\,mm$		
Effective Height:	$h_b := L_b$		
Required Thicknesses:	$t_b := \frac{P\cdot d_1}{2\cdot\left[S_{bd}\cdot E_{jb}\cdot W_b - P\cdot(1 - Y_b)\right]}$		
	$t_b = 0.0061\,in$	$t_r := \frac{P\cdot D_r}{2\cdot(S_{rd}\cdot E_{jr}\cdot W_r + P\cdot Y_r)}$	
	$t_b = 0.154\,mm$	$t_r = 0.033\,in$ $\quad t_r = 0.838\,mm$	
Attachment Type:	Inserted w/Full Pen Weld		
Branch Angle to Header:	$\alpha := 90\cdot deg$		

REINFORCEMENT OF RUN PIPE WELDED BRANCH CONNECTION Continued

Limits Of Reinforcement:

$0.5d_1 + \left[\left(T_b - c\right) + \left(T_r - c\right)\right] = 0.84\,in$ $\quad 0.5d_1 + \left[\left(T_b - c\right) + \left(T_r - c\right)\right] = 21.3\,mm$

$$d_2 := min\left[\begin{array}{c} max\left[\begin{array}{c} 0.5d_1 + \left(T_b - c\right) + \left(T_r - c\right) \\ d_1 \end{array}\right] \\ D_r \end{array}\right] \qquad d_2 = 1.207\,in \qquad d_2 = 30.664\,mm$$

$$L4 := min\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] \qquad L4 = 0.380\,in \qquad L4 = 9.644\,mm$$

$$\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] = \left(\begin{array}{c} 3.125 \\ 0.456 \\ 0.38 \end{array}\right) in$$

$$\left[\begin{array}{c} L_b \\ 2.5\cdot\left(T_r - c\right) \\ 2.5\cdot\left(T_b - c\right) + T_r \end{array}\right] = \left(\begin{array}{c} 79.4 \\ 11.6 \\ 9.6 \end{array}\right) mm$$

Strength Reduction Factors: For an Inserted Branch Attachment

$$\frac{S_{bd}\cdot E_{jb}}{S_{rd}\cdot E_{jr}} = 1 \qquad f_{r1} := min\left(\begin{array}{c} 1.0 \\ \frac{S_{bd}\cdot E_{jb}}{S_{rd}\cdot E_{jr}} \end{array}\right) \qquad f_{r1} = 1$$

Area Calculations:

Required Reinforcement Area = $A_1 := t_r\cdot d_1\cdot(2 - sin(\alpha))$ $\quad A_1 = 0.04\,in^2$ $\quad A_1 = 26\,mm^2$

Available Areas: Based upon an inserted nozzle

Header Wall: $A_2 := \left(2\cdot d_1 - d_1\right)\cdot\left(T_r - t_r - c\right)$ $\quad A_2 = 0.18\,in^2$ $\quad A_2 = 116\,mm^2$

Nozzle OD Projection: $A_3 := \frac{2\cdot f_{r1}\cdot\left(T_b - t_b - c\right)}{sin(\alpha)}\cdot min\left(L4, h_b\right)$ $\quad A_3 = 0.036\,in^2$ $\quad A_3 = 23\,mm^2$

Total Area Available For Reinforcement:

$A_A := \left(A_2 + A_3\right)$ $\quad A_A = 0.217\,in^2$ **>** $A_1 = 0.04\,in^2$ **. . . . OK**

$A_A = 140\,mm^2$ **>** $A_1 = 26\,mm^2$ **. . . . OK**

The Branch Opening Is Adequately Reinforced

MDMT & IMPACT TEST REQUIREMENTS

MATERIAL MDMT'S PER TABLE A-1:

ASTM A106-B PIPE: PER CURVE B IN FIG 323.2.2A WHICH = -20 degF (-29 degC) FOR THICKNESSES NOT EXCEEDING 1/2".

ASTM A-105 FORGING: -20 degF (-29 degC)

THE LIMITING MDMT PER TABLE A-1 = $MDMT = -20\,degF$

PER TABLE 323.2.2, IMPACT TESTS ARE NOT REQUIRED FOR BASE METALS, WELD METALS, OR HAZ'S, FOR THE ABOVE SPECIFIED MDMT.

HYDROSTATIC TEST: [345.4.2]

ALLOWABLE STRESSES @ DESIGN TEMPERATURE ARE LESS THAN ALLOWABLE STRESSES @ TEST (AMBIENT) TEMPERATURE.

Material	Allowable Stresses At Design Temerature		Allowable Stresses At Test Temp	
ASTM A106 Gr 6	$S_{dp} := 20000 \cdot psi$	$S_{dp} = 137895\,kPa$	$S_{dpa} := 20000 \cdot psi$	$S_{dpa} = 137895\,kPa$
ASTM A105	$S_{df} := 21600 \cdot psi$	$S_{df} = 148926\,kPa$	$S_{dfa} := 23300 \cdot psi$	$S_{dfa} = 160648\,kPa$

Test to Design Stress Ratios $\frac{S_{dpa}}{S_{dp}} = 1$ $\frac{S_{dfa}}{S_{df}} = 1.079$

Minimum Hydrotest pressure = $P_{T\_min} := 1.5 \cdot MAWP \cdot min\left(\frac{S_{dpa}}{S_{dp}}, \frac{S_{dfa}}{S_{df}}\right)$ $P_{T\_min} = 300\,psi$

$P_{T\_min} = 2068\,kPa$

$\frac{P_{T\_min}}{1.5} = 200\,psi$ < $P_{150a} := 285 \cdot psi$ = Flange rating at 100 degF ***OK***

$\frac{P_{T\_min}}{1.5} = 1379\,kPa$ < $P_{150a} = 1965\,kPa$ = Flange rating at 37.8 degC

TEST WITH WATER AT $P_T := P_{T\_min}$ $P_T = 300\,psi$ $P_T = 2068\,kPa$

SOFTWARE VERIFICATION

This calculation was produced using the computer software program MathCAD v.11.2a, (MathSoft, Inc., Cambridge, MA). MathCAD's `Live Document Interface' allows numeric & symbolic calculations, text & graphics to be directly entered and edited anywhere in the document. Variables and constants must be defined prior to use in an mathematical equation. The operator ":=" in mathematical equations defines that the variable or expression on the left is equal to the expression or value on the right. The value to the right of an "=" sign is the mathematically precise value of the variable or expression to the left, including the justification of units. Since there are no hidden formulas in this calculation, the `verification' required of spreadsheet or `canned' computer calculations is not required. The numeric results will be correct if the variables & mathematical expressions are correctly defined.

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KOMAX SYSTEMS·INC
MIXING BY DESIGN

SECTION 04

MTR

178612H44

UNITED STATES STEEL

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 11/10/08
TIME: 11:23:04
SERIAL NO: L0026524

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	VEHICLE ID	
DR45553 06		178612-HOU		

SOLD TO ADDRESS	MAIL TO ADDRESS	VENDOR
KELLY PIPE CO LLC 8200 EAST 96TH AVE HENDERSON CO 80640	KELLY PIPE CO LLC 8200 EAST 96TH AVE HENDERSON CO 80640	USS TUBULAR PRODUCTS 2199 EAST 28TH ST LORAIN, OH 44055

SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-*44TH ED DTD OCT 2007 AND ISO 3183:2007 MOD PSL-1 GRADE B AND GRADE X42 R N OR Q ASTM A53-*06A ASTM A106-*06A GRADE B QUAD STENCIL SPECIAL OD TOLERANCE ASME SA53-*2007 EDITION GRADE B BLK REG MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 *:2003/COR.1:2005 AND MR0103-2007

MATERIAL COND: AS ROLLED | O.D.: 12.750 (323.850) in (mm) | WALL: 0.406 (10.312) in (mm)

PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH IN	YIELD PSI	EXT %	TENSILE PSI	Y/T	ELONG % (IN 2")	HARDNESS SCALE: HRB	MIN HYDRO PSI	DISCUITIES
				MIN: 42100 MAX:	.50	MIN: 60200 MAX:	MAX:	MIN: 28.0	MIN: MAX: 99.0	2280	5
B68331	STRIP/L/B	AR	1.500	56000	.50	78000	0.72	43.0	B 79.6	2280	5
		**	END OF DATA THIS	SHEET	**						

LEGEND: L - LONGITUDINAL, U - UPSET, T - TRANSVERSE, NM - NORMALIZED, QT - QUENCH & TEMPERED, SR - STRESS RELIEVED, AR - AS ROLLED, TR - THERMOMECHANICAL ROLLED, B - BODY, W - WELD

PRODUCT IDENTIFICATION	TYPE	C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CE	CO	CE* MAX
B68331	HEAT	20	104	007	005	18	05	04	05	02	053		03	0001	002	001		.50
B68331	PROD	20	103	006	005	17	04	04	05	02	053		03	0000	004	002		.40
B68331	PROD	19	103	006	005	16	04	04	05	02	051		03	0000	004	001		.39
		** END OF DATA THIS SHEET **																

*C.E. IS BASED ON THE FOLLOWING EQUATION(S): CE=C+ (MN/6) + (CR+MO+V) /5+ (NI+CU) /15

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

UNITED STATES STEEL

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 11/10/08
TIME: 11:23:04
SERIAL NO: L0026524

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER
DR45553 06		178612-HOU

MATERIAL COND: AS ROLLED

O.D.: 12.750 (323.850) in (mm)

WALL: 0.406 (10.312) in (mm)

PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	CHARPY V-NOTCH IMPACT TESTING											
					DIR	TEST LOC.	TEMP	SIZE	TEST COND.	FT-LBS				% SHEAR			
										1	2	3	AVG	1	2	3	AVG
							DEG										
B68331	OK																
			** END OF DATA THIS SHEET **														

LEGEND: L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE

TESTING / INSPECTION INFORMATION

TEST / INSPECTION	YES	RESULTS / COMMENTS
FULL LENGTH VISUAL	X	
FULL LENGTH EMI	X	OD X ODMD ____ L ____ LT X 10.0% NOTCH
FULL LENGTH MPI		
FULL LENGTH UT		ID ____ ODMD ____ L ____ LT ____
END AREA INSPECTION (PLAIN END)	X	MPI X UT ____
SPECIAL END AREA (SEA) INSP		MPI ____ UT ____
FULL LENGTH DRIFT		DRIFT MANDREL SIZE:

ADDITIONAL NOTES/COMMENTS

MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.
PRODUCT WAS HOT ROLLED AND HOT FINISHED

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: J. MAJKRZAK - MANAGER, Q.A.

DATE: 11/10/08

**

UNITED STATES STEEL

TUBULAR PRODUCTS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 12/31/08
TIME: 04:22:03
SERIAL NO: L0027556

BILL OF ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	VEHICLE ID
DR45553 11	879403	178612-HOU	NS192646

SOLD TO ADDRESS	MAIL TO ADDRESS	VENDOR
KELLY PIPE CO LLC 8200 EAST 96TH AVE HENDERSON CO 80640	KELLY PIPE CO LLC 8200 EAST 96TH AVE HENDERSON CO 80640	USS TUBULAR PRODUCTS 2199 EAST 28TH ST. LORAIN, OH 44055

SPECIFICATION AND GRADE

PIPE CARBON SMLS STD PIPE API 5L-*44TH ED DTD OCT 2007 AND ISO 3183:2007 MOD PSL-1 GRADE B AND GRADE X42 R N OR Q ASTM A53-*06A ASTM A106-*06A GRADE B QUAD STENCIL SPECIAL OD TOLERANCE ASME SA53-*2007 EDITION GRADE B BLK REQ MILL COAT PE BEV 30 DEG MEETING ALL THE APPLICABLE REQUIREMENTS OF NACE STANDARD MR-01-75 *:2003/COR.1:2005 AND MR0103-2007

MATERIAL COND: AS ROLLED | OD: 16.000(406.400) in (mm) | WALL: 0.375 (9.525) in (mm)

PRODUCT IDENTIFICATION	TENSILE TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH IN	YIELD PSI	EXT %	TENSILE PSI	Y/T	ELONG % IN 2"	HARDNESS SCALE: HRB	MIN HYDRO PSI	CHRT(SEC)
				MIN: 42100 MAX:		MIN: 60200 MAX:	MAX:	MIN: 28.0	MIN: MAX: 99.0	1680	5
C68161	STRIP/L/B	AR	1.500	53000	.50	78000	0.68	41.0	B 82.5	1680	5
X65733	STRIP/L/B	AR	1.500	50000	.50	74500	0.67	42.0	B 80.3	1680	5
		**	END OF DATA THIS SHEET			**					

LEGEND: L - LONGITUDINAL, U - UPSET, T - TRANSVERSE, NM - NORMALIZED, QT - QUENCH & TEMPERED, SR - STRESS RELIEVED, AR - AS ROLLED, TR - THERMOMECHANICAL ROLLED, B - BODY, W - WELD

PRODUCT IDENTIFICATION	TYPE		C	MN	P	S	SI	CU	NI	CR	MO	AL	R	V	B	TI	CB	CO				CE* MAX .50
C68161	HEAT		.20	1.08	.009	.006	.15	.02	.02	.05	.02	.030		.03	.0003	.003	.003					.40
C68161	PROD		.22	1.09	.007	.005	.14	.02	.02	.06	.01	.028		.04	.0000	.003	.002					.42
C68161	PROD		.20	1.10	.006	.005	.14	.02	.02	.06	.01	.031		.03	.0000	.003	.002					.40
X65733	HEAT		.19	1.04	.010	.006	.14	.02	.01	.05	.01	.023		.03	.0002	.003	.001					.38
X65733	PROD		.20	1.06	.008	.006	.14	.02	.00	.05	.01	.032		.04	.0000	.003	.001					.40
X65733	PROD		.20	1.06	.009	.006	.14	.02	.01	.05	.01	.030		.04	.0000	.004	.001					.39
			** END OF DATA THIS SHEET **																			

*C.E. IS BASED ON THE FOLLOWING EQUATION(S): CE=C+(MN/6)+(CR+MO+V)/5+(NI+CU)/15

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT.

UNITED STATES STEEL

TUBULAR PRODUCTS

CERTIFIED TEST REPORT

(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 12/31/08
TIME: 04:22:03
SERIAL NO: L0027556

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	
DR45553 11	R79403	178612-EOU	0024512

MATERIAL COND: AS ROLLED

O.D.: 16.000 (406.400) in (mm) WALL: 0.375 (9.525) in (mm)

PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	NDT COLLAPSE	CHARPY V-NOTCH IMPACT TESTING DIR.	TEST LOC.	TEMP.	SIZE	TEST COND.	FT-LBS 1	FT-LBS 2	FT-LBS 3	FT-LBS AVG	% SHEAR 1	% SHEAR 2	% SHEAR 3	% SHEAR AVG
					DEG												
C68161	OK																
X65733	OK																
				** END OF DATA THIS SHEET **													

LEGEND L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE

TESTING / INSPECTION INFORMATION

TEST / INSPECTION	YES	RESULTS / COMMENTS
FULL LENGTH VISUAL	X	
FULL LENGTH EMI	X	OD X, ODID ____ L ____ L/T X 10.0% NOTCH
FULL LENGTH MPI		
FULL LENGTH UT		
END AREA INSPECTION (PLAIN END)	X	ID ____ ODID ____ L ____ L/T ____
SPECIAL END AREA (SEA) #/SP		MPI X UT ____
FULL LENGTH DRIFT		MPI ____ UT ____
		DRIFT MANDREL SIZE:

ADDITIONAL NOTES/COMMENTS

MELTED AND MANUFACTURED IN THE USA. NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY BEARING EQUIPMENT IS PROTECTED BY A DOUBLE BOUNDARY OF CONTAINMENT.
PRODUCT WAS HOT ROLLED AND HOT FINISHED

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: J. MAJKRZAK - MANAGER, Q.A.

DATE 12/31/08

HENGYANG VALIN STEEL TUBE CO., LTD
Add: 10 Dalixincun, Hengyang City, Hunan, China
Tel and Fax: +86 734 8873739 8872942
Cable: 6993
P.C. 421001

MILL CERTIFICATE

Contract No.: 2110000757-1
Name of Customer: KELLY PIPE 178805
ORDER NO.: MSI-5596 (LOT A) P.O. NO.: ~~175805~~
DESCRIPTION: SEAMLESS CARBON STEEL PIPE
TOTAL: 321PIECES, 43BUNDLES, 70.167MT, 11060FT

Date: OCT. 14, 2008
Page:3/3

SPEC: ASTM A53B-2007/A106B-2006a, ASME SA53B/SA106B-2004, API 5LB/X42, PSL1-2004, NACE MR-0175-2003

CERTIFICATE NO: 08-1-10-8

NO.	BATCH NO.	HEAT NO.	STEEL GRADE	SIZE	BUNDLES	PIECES	FEET	QUANTITY (MT)	ACTUAL WEIGHT(MT)
4	889401202	2F-2932	B/X42	4"*0.237"*40FT	25	176	7040	34.496	N/A
5	889103905	0813209	B/X42	4"*0.337"*40FT	8	56	2240	15.24	N/A
6	889400311	0813373	B/X42	4"*0.531"*20FT	2	16	320	3.27	N/A
	889400610	0813217	B/X42	4"*0.531"*20FT	3	24	480	4.906	N/A
7	889300234	0813372	B/X42	4"*0.674"*20FT	5	49	980	12.255	N/A

NO.	DELIVERY CONDITION	NONDESTRUCTIVE TEST	
		ET	UT
4	HOT-ROLLED	OK	N/A
5	HOT-ROLLED	OK	N/A
6	HOT-ROLLED	OK	N/A
	HOT-ROLLED	OK	N/A
7	HOT-ROLLED	OK	N/A

CHEMICAL COMPOSITION %

C	SI	Mn	P	S	Cu	Ni	Cr	Mo	V	Sn	Pb		
0.23	0.30	0.50	0.009	0.010	0.11	0.02	0.05	0.02	0.01	0.013	0.001		
0.20	0.23	0.40	0.010	0.006	0.09	0.05	0.04	0.01	0.01	0.008	0.002		
0.20	0.29	0.43	0.009	0.002	0.10	0.04	0.04	0.02	0.01	0.010	0.002		
0.21	0.23	0.45	0.016	0.005	0.12	0.03	0.05	0.01	0.01	0.011	0.001		
0.18	0.23	0.41	0.007	0.008	0.09	0.04	0.04	0.03	0.01	0.008	0.001		

NO	σb (PSI) TENSILE STRENGTH	σs (PSI) YIELD STRENGTH	δ (%) ELONGATION
	Strip ,L bo=19mm,Lo=50mm		
4	68875	45675	36.5
5	71775	47125	37
6	67425	42050	41.5
	67425	43500	31
7	bar, L ,do=12.5mm Lo=50mm		
30.1	70325	52200	28.5

IMPACT TEST				HARDNESS	HYDROSTATIC TEST	FLATTEN TEST	BEND TEST
Temp	Diam(mm)	AKV (J)	Orientation				
N/A	N/A	N/A	N/A	HRC 1	2650PSI	OK	N/A
N/A	N/A	N/A	N/A	HRC 2.5	3000PSI	OK	N/A
N/A	N/A	N/A	N/A	HRC 1	3000PSI	OK	N/A
N/A	N/A	N/A	N/A	HRC 2.5	3000PSI	OK	N/A
N/A	N/A	N/A	N/A	HRC 2.5	3000PSI	OK	N/A

REMARKS: 1. We hereby certify that the material has been manufactured, sampled, tested and inspected in accordance with the required standards.
2. Properties compliance to DIN 50049 3.1.B/UNI EN 10204 3.1B.
3. BRINELL /Rockwell hardness certified to NACE MR-0175-2003.
4. Origin: Made in China.
5. SPECIMEN SIZE: (Pipe end, Longitudinal, Gauge Length=2")
A. For pipes≤1" full length specimen were used;
B. For pipes > 1" longitudinal strip specimen were used; the width of the gauge length portion is 3/4".

QUALITY MANAGER:

HENGYANG VALIN STEEL TUBE CO., LTD. 衡阳华菱钢管有限公司 HUNAN CHINA

AC-009

CERTIFICATE OF INSPECTION & TEST

ORIGINAL

ST&H CORPORATION
411-3 Shinwol-ri, Jinryemyun, Gimhae-si Gyungnam, Korea
Tel:82.51.744-4680(5 line) Fax:82.51.744-4670
E-mail : stcorpa@kornet.net

(EN 10204 3.1)

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Report No : MSI 5046
Date: JUL.09.2009

Customer :

Contract No. : 99195

Spec. For Material : ASTM A105-05/ASME SA105(NACE MR-0175)

Chemical Composition (%)		C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	Nb
Heat No.	MAX	0.350	0.350	1.050	0.035	0.040	0.400	0.300	0.120	0.400	0.080	
	MIN		0.100	0.600								
04981		0.220	0.266	0.810	0.017	0.018	0.011	0.006	0.002	0.008	0.001	

Tension Test

Size of Specimen(mm)			Yield Strength MPa	Tensile Strength MPa	Elongation %	Red of Area %
Dia	Gage Length					
12.5	50	MAX				
		MIN	250.000	485.000	22.000	30.000
12.5	50		362.210	533.770	31.200	69.620

Charpy Impact Test (10x10 mm Specimen Size)

Individual min	Average min	Notch Type	Test Result ①	②	③	Average	Temp

Hardness Test (HB)
187
137
137-143

Bending Test 90:120(180°)

Heat Treatment

AS FORGED

Dimensional Inspection

ANSI B 16.5

GOOD

Ultrasonic Examination

N/A

Magnaflux Examination

N/A

Remarks :

*CE = 0.36 (LONG FORMULA)

ITEM / SIZE	Q'TY	ITEM / SIZE	Q'TY	ITEM / SIZE	Q'TY
150LBS SORF 12"	100	150LBS SORF 24"	25	150LBS BLRF 10"	60
150LBS SORF 14"	30	150LBS WNRF STD 14"	30	150LBS BLRF 12"	60
150LBS SORF 16"	30	150LBS WNRF STD 16"	30	150LBS BLRF 14"	25
150LBS SORF 18"	25	150LBS WNRF STD 18"	20	150LBS BLRF 16"	25
150LBS SORF 20"	25	150LBS WNRF STD 20"	19	BLANK	

NOTE :
1MPa = 145.037 psi
1MPa = 0.145037 ksi
1psi = 6894.76 MPa
1ksi = 6.89476 MPa

W.C:Water Cool O.C:Oil Cool
A.C:Air Cool N.A:Non Action
N:Normalized A:Annealed
Q.T:Quenched and Tempered
N.T:Normalized and Tempered

1. Forged steel flanges manufactured in accordance with ASTM A105-03 and ASME SA105-03. Dimensions in accordance with ANSI B16.5 for sizes up to and including 24".
2. Sizes larger than 24" as specified by purchaser.
3. Flanges to be painted black and all bolt holes to be spot faced.
4. Flange serrations to be in accordance with MSS-SP 6.

Witnessed by

Manager of Q.A Dept.

ST&H CORPORATION

STP-095

BOLTEX ELECTRONIC MATERIAL TEST REPORT

REPORT FOR HEAT CODE: J123

Material Spec:	SA105-05
Item Number:	10079
Description:	12" 150 RF WN XH
Part Number:	1-1120201

Chemical		Mechanical	
C	.18	Hardness - BHN	163
Si	.24	Charpy	
Mn	.85	Ft-Lb	
P	.024	MLE - %	
S	.021	Shear Fracture -%	
Cr	.19	Test Temperature	
Al	.001	Tensile - psi	79400
Cu	.39	Yield - psi	42300
Ni	.11	Elongation - %	29.6
Mo	.04	Area Reduction - %	62.5744
V	.004		
Cb	.001		
Carbon Equivalence	.4018	-	

We certify our flanges are capable of passing a hydrostatic test compatible with their rating and all test results and process information contained herein are correct and true as contained in company records. All flanges meet NACE MRO-175 and/or MRO-103 Latest Revision.

Our quality system has been registered by ABS to ISO 9001, certification no.: 30696. Test results comply with: EN 10204-3.1. Our flanges satisfy the material requirements for PED 97/23/EC annex 1-4.3.

Not withstanding the absence of a signature, the organization submitting either a printed certificate or an EDI transmitted certificates is responsible for content or the report. (ASTM/A 961-04a Section 19.4)

X-2009

CERTIFICATE OF INSPECTION & TEST

ORIGINAL

(EN 10204 3.1)

ST&H CORPORATION
411-3 Shinwol-ri, Jinryemyun, Gimhae-si Gyungnam, Korea
Tel:82.51.744-4680(5 line) Fax:82.51.744-4670
E-mail : stcorpn@kornet.net

We hereby certify that the material herein has been made and tested in accordance with the above specification and also with the requirements called for by the above order.

Report No : MSI 5046
Date: JUL.09.2009

Customer :

Contract No. : 99195

Heat Treatment

Spec. For Material : ASTM A105-05/ASME SA105(NACE MR-0175)

Chemical Composition (%)		C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	Nb
Heat No.	MAX	0.350	0.350	1.050	0.035	0.040	0.400	0.300	0.120	0.400	0.080	
	MIN		0.100	0.600								
03390		0.225	0.239	0.830	0.024	0.011	0.013	0.012	0.002	0.007	0.002	

AS FORGED

Tension Test						Charpy Impact Test (10x10 mm Specimen Size)						
Size of Specimen(mm)			Yield Strength MPa	Tensile Strength MPa	Elongation %	Red of Area %	Individual	Average	Notch Type	Hardness Test (HB)	Bending Test 90-120(180°)	
Dia	Gage Length						min	min				
12.5	50	MAX					Test Result			187		
		MIN	250.000	485.000	22.000	30.000	① ② ③	Average	Temp.	137		
12.5	50		355.780	545.960	31.900	67.935				143-149		

Dimensional Inspection

ANSI B16.5

GOOD

ITEM / SIZE	Q'TY	ITEM / SIZE	Q'TY	ITEM / SIZE	Q'TY
150LBS SORF 2"	300	150LBS SORF 10"	100	150LBS WNRF STD 8"	100
150LBS SORF 3"	300	150LBS WNRF STD 2"	200	150LBS WNRF STD 10"	80
150LBS SORF 4"	300	150LBS WNRF STD 3"	200	150LBS BLRF 2"	200
150LBS SORF 6"	200	150LBS WNRF STD 4"	200	150LBS BLRF 3"	200
150LBS SORF 8"	200	150LBS WNRF STD 6"	120	150LBS BLRF 4"	200

Ultrasonic Examination

N/A

Magnaflux Examination

N/A

Remarks :

*CE = 0.37 (LONG FORMULAR)

NOTE :
1MPa = 145.037 psi
1MPa = 0.145037 ksi
1psi = 6894.76 Pa
1ksi = 6.89476 MPa

W.C:Water-Cool O.C:Oil Cool
A.C:Air Cool N.A:Non Action
N:Normalized A:Annealed
Q.T:Quenched and Tempered
N.T:Normalized and Tempered

1. Forged steel flanges manufactured in accordance with ASTM A105-03 and ASME SA105-03. Dimensions in accordance with ANSI B16.5 for sizes up to and including 24".
2. Sizes larger than 24" as specified by purchaser.
3. Flanges to be painted black and all bolt holes to be spot faced.
4. Flange serrations to be in accordance with RSS-SP 6.

Witnessed by

Manager of Q.A Dept.

STP-095

ST&H CORPORATION

BOLTEX ELECTRONIC MATERIAL TEST REPORT

REPORT FOR HEAT CODE: YR8

Material Spec:	SA105-05
Item Number:	502
Description:	1" 150 RF WN STD
Part Number:	1-1010251

Chemical		Mechanical	
C	.18	Hardness - BHN	140
Si	.23	Charpy	
Mn	1.1	Ft-Lb	
P	.007	MLE - %	
S	.025	Shear Fracture - %	
Cr	.12	Test Temperature	
Al	.022	Tensile - psi	70615
Cu	.01	Yield - psi	43645
Ni	.01	Elongation - %	31.75
Mo	0	Area Reduction - %	64.7
V	0		
Cb	.001		
Carbon Equivalence	.3887		

We certify our flanges are capable of passing a hydrostatic test compatible with their rating and all test results and process information contained herein are correct and true as contained in company records. All flanges meet NACE MR0-175 and/or MR0-103 Latest Revision.

Our quality system has been registered by ABS to ISO 9001, certification no.: 30696. Test results comply with: EN 10204-3.1. Our flanges satisfy the material requirements for PED 97/23/EC annex 1-4.3.

Not withstanding the absence of a signature, the organization submitting either a printed certificate or an EDI transmitted certificates is responsible for content or the report. (ASTM/A 961-04a Section 19.4)

6600 SOUTH HARLEM AVENUE
ARGO, IL 60501-1700
PHONE: (708) 594-1700
FAX: (708) 458-0106

WELDBEND

MATERIAL TEST REPORT

KELLY PIPE CO. LLC
11680 BLOOMFIELD AVENUE
SANTA FE SPRINGS, CA
90670-4608
Attn: Carl Matson

Description										Heat Number				Steel Producer			
C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Cb*	V	Ten	Yield	Elong	ROA	BHN	CE	RevYr
2" Class 150 Welding Neck StdB RF										x				ALTON STEEL			
0.2	1.16	0.012	0.02	0.22	0.19	0.09	0.15	0.03	0.01	0.03	77700	47400	28	62.6	162	0.454	05
3" Class 150 Welding Neck StdB RF										n				ALTON STEEL			
0.2	0.97	0.009	0.023	0.24	0.23	0.075	0.086	0.021	0.009	0.025	80400	50300	23	34	162	0.408	05

All flanges meet the requirements of ASTM A-105 (and SA-105)
All fittings meet the requirements of ASTM-A-234 WPB, (and SA-234) and are seamless unless noted.

Starting Material Seamless Pipe for elbows, tees and reducers; Plate for and welded fittings.

ISO 9001:2000 CERTIFIED MANUFACTURER
All flanges and fittings meet NACE MR0-175 – Latest Revision
All flanges and fittings meet NACE MR0-103 – Latest Revision

* *No longer required under the current standards*

Quality System Registrar

August 13, 2009

Report sent digitally. Signature available upon request.

Quality Assurance Department
Test Results herein are correct as contained in test records retained by the company
in accordance with EN 10 204 Para 3.1.B
in accordance with PED 97/23/EC, 7/2

MILL TEST REPORTS

Bonney Forge
14496 Croghan Pike
Mt. Union, PA 17066

CERTIFIED MILL TEST REPORT

INDUSTRIAL VALCO INC. 08/13/09

LOT NO. CHEMICAL ANALYSIS, PHYSICAL PROPERTIES, REMARKS

57781 3" X 1 1/2" 3M/6M A105 Hexagon Bushing Threaded

C	0.180	MN	1.060	P	0.010	S	0.020	SI	0.170
NI	0.020	CR	0.030	MO	0.010	CU	0.100	CO	0.003
V	0.000	AL	0.022	NB	0.013				
CE(LONG FORMULA) = 0.373									
T/S 81500 Y/S 60125 EL 29.550 RA 58.800									
BRINELL HARDNESS: 147									

Click here for Original Steel Mill Certification

1. THE MATERIAL SUPPLIED MEETS THE REQUIREMENTS OF NACE MRO175-2002 AND MRO103-2005
2. THE MATERIAL SUPPLIED WAS INSPECTED AND MANUFACTURED IN ACCORDANCE WITH EN DIN 10204 3.1.B.
3. CERTIFYING ASTM A105-05 / ASME SA105-04 EDITION

THIS DOCUMENT HAS BEEN ELECTRONICALLY SUBMITTED.

BONNEY FORGE

MILL TEST REPORTS

Bonney Forge
14496 Croghan Pike
Mt. Union, PA 17066

CERTIFIED MILL TEST REPORT

INDUSTRIAL VALCO INC. 08/13/09

LOT NO.	CHEMICAL ANALYSIS, PHYSICAL PROPERTIES, REMARKS
4372	2" X 1" 3M/6M A105 Hexagon Bushing Threaded

C	0.200	MN	1.020	P	0.007	S	0.022	SI	0.200
NI	0.040	CR	0.040	MO	0.010	CU	0.170	CO	0.004
V	0.002	AL	0.025	NB	0.014				

CE(LONG FORMULA) = 0.394

T/S 79119 Y/S 50391 EL 32.000 RA 57.000

BRINELL HARDNESS: 161

Click here for Original Steel Mill Certification

1. THE MATERIAL SUPPLIED MEETS THE REQUIREMENTS OF NACE MR0175-2002 AND MR0103-2005
2. THE MATERIAL SUPPLIED WAS INSPECTED AND MANUFACTURED IN ACCORDANCE WITH EN DIN 10204 3.1
3. CERTIFYING ASTM A105-05 / ASME SA105-04 EDITION

THIS DOCUMENT HAS BEEN ELECTRONICALLY SUBMITTED.

BONNEY FORGE

MILL TEST REPORTS

Bonney Forge
14496 Croghan Pike
Mt. Union, PA 17066

CERTIFIED MILL TEST REPORT

INDUSTRIAL VALCO INC. 08/13/09

LOT NO.	CHEMICAL ANALYSIS, PHYSICAL PROPERTIES, REMARKS
4417	1" X 3/4" 3M/6M A105 Hexagon Bushing Threaded

C	0.200	MN	1.020	P	0.008	S	0.017	SI	0.230
NI	0.040	CR	0.040	MO	0.011	CU	0.150	CO	0.003
V	0.001	AL	0.020	NB	0.017				

CE(LONG FORMULA) = 0.393

T/S 77200 Y/S 52600 EL 28.000 RA 38.900

BRINELL HARDNESS: 168

Click here for Original Steel Mill Certification

1. THE MATERIAL SUPPLIED MEETS THE REQUIREMENTS OF NACE MR0175-2002 AND MR0103-2005
2. THE MATERIAL SUPPLIED WAS INSPECTED AND MANUFACTURED IN ACCORDANCE WITH EN DIN 10204 3.1
3. CERTIFYING ASTM A105-05 / ASME SA105-04 EDITION

THIS DOCUMENT HAS BEEN ELECTRONICALLY SUBMITTED.

柏龍鋼工股份有限公司
高雄縣仁武鄉烏林村仁心路 303 號
BOTH-WELL STEEL FITTINGS CO., LTD.
NO.303, JEN-HSIN ROAD JEN-WU HSIANG
KAOHSIUNG HSIEN, TAIWAN R.O.C.(814/60)
TEL: 886-7-371-0497, 371-1536, 372-0260 FAX: 886-7-371-3864 , 371-3882
web site:http//www.bothwell.com.tw e-mail:bothwell@www.bothwell.com.tw or box@mail.bothwell.com.tw

An ISO 9001:2000 Registered Manufacturer

MILL TEST & INSPECTION CERTIFICATE

ACCORDING TO EN10204/DIN50049/3.1.B

ORIGIN:TAIWAN

CUSTOMER:S.I.LEO INDUSTRIES, INC.
CERT NO:83294 ORDER NO: 98296
INVOICE NO: BW089707032/A
L/C NO: 64467723
DATE: 11/25/08
PAGE: 5

ITEM	BOTH WELL HT.CD.	RAW MATERIAL HEAT NO.	DESCRIPTION	QUANTITY
012	2989	304640	90D ELBOW 1" 3000# NPT	280 PC
012	3020	304909	90D ELBOW 1" 3000# NPT	20 PC
013	2969	304326	90D ELBOW 2" 3000# NPT	200 PC
014	2939	082-04053	90D ELBOW 3" 3000# NPT	50 PC
015	2938	082-04052	90D ELBOW 4" 3000# NPT	20 PC
016	2974	281447	90D ELBOW 2-1/2" 3000# NPT	40 PC
017	2990	304643	45D ELBOW 2" 2000# NPT	50 PC

SPECIFICATION:
ASTM A105N -05
ASME SA105N -A06

DIMENSION:
ASME B16.11-2005

SURFACE:
BY VISUAL...GOOD

CHEMICAL COMPOSITION (%)

ITEM	BOTH WELL HT.CD	C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Cb(Nb)	N
Min		-	0.100	0.600	-	-	-	-	-	-	-	-	-
Max		0.350	0.350	1.050	0.035	0.040	0.400	0.300	0.400	0.120	0.080	-	-
012	2989	0.180	0.190	0.870	0.015	0.012	0.090	0.060	0.040	0.010	0.004	0.001	-
012	3020	0.190	0.200	0.890	0.018	0.011	0.160	0.070	0.050	0.010	0.002	0.001	-
013	2969	0.190	0.210	0.840	0.015	0.014	0.130	0.050	0.060	0.010	0.002	0.001	-
014	2939	0.210	0.240	1.040	0.010	0.007	0.010	0.010	0.010	0.010	0.001	0.000	-
015	2938	0.210	0.220	1.010	0.016	0.012	0.020	0.030	0.010	0.001	0.001	0.000	-
016	2974	0.200	0.280	0.980	0.008	0.005	0.130	0.050	0.030	0.001	0.001	0.000	-
017	2990	0.190	0.190	0.850	0.019	0.015	0.150	0.060	0.060	0.010	0.002	0.001	-

MECHANICAL TEST

ITEM	BOTH WELL HT.CD	Tensile Strength (KSI)	Yield Strength (KSI)	Elongation (%)	R of A (%)	Hardness (AVG.) (HB)
Min		70.0	36.0	22.0	30.0	-
Max		-	-	-	-	187
012	2989	78.4	56.6	32.4	65.3	146
012	3020	75.3	49.3	32.8	66.3	143
013	2969	75.3	51.8	33.4	67.6	141
014	2939	75.6	53.3	33.6	76.0	141
015	2938	79.0	57.9	32.8	77.9	142
016	2974	74.5	55.9	33.6	77.6	141
017	2990	74.4	52.1	33.4	66.3	141

Remark:
NORMALIZED
960°C A.C.

WE CERTIFY THE ABOVE MENTIONED FITTINGS HAVE BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH THE SPECIFICATIONS SHOWN

Q.C. MANAGER
CHIN CHENG HSIEH

INSPECTOR
CHUN CHIEH HUANG

BW-00839 REV10

ORIGINALS

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SECTION 05

HYDROSTATIC TEST REPORT

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #1

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #2

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #3

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #4

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
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14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #5

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #6

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #7

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

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Los Angeles, California 90002
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14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #8

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

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Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

19 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #9

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D.P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/19/2010

Joey Gou

ALAMEDA TANK COMPANY

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Los Angeles, California 90002
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19 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #10

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/19/2010

Joey Gou

ALAMEDA TANK COMPANY

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Los Angeles, California 90002
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19 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55789 unit #11

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/19/2010
Joey Gou

ALAMEDA TANK COMPANY

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12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #1

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010
Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
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12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #2

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010
Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
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12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #3

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

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12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #4

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
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14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #5

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010
Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
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14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #6

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010
Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #7

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #8

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D.P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
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19 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #9

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/19/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
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19 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #10

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/19/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
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19 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55790 unit #11

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/19/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #1

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #2

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #3

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010
Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #4

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

12 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #5

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/12/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #6

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010
Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #7

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D.P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #8

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D.P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

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Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #9

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010
Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #10

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

ALAMEDA TANK COMPANY

8610 Juniper Street
Los Angeles, California 90002
(323) 582-4549 Fax (323) 582-9765

14 Jan 2010
Komax Systems Inc.
15301 Graham St
Huntington Beach, Ca. 92649

Reference
Job #25086
Model #GLC-55791 unit #11

CERTIFICATION OF HYDRO TEST

Above Named Model was tested for (1) one hour at 300psig per the A.S.M.E. B31.3 without any leaks or failures.

Tested: Alameda Tank Company

D. P. Klinkert

D P Klinkert
Quality Control Manager

Witnessed: Komax Systems Inc.

Joey Gou 1/14/2010

Joey Gou

SECTION 06

RADIOGRAPHIC TEST REPORT

R&R NDE Services
1427 W. 14th Street
Long Beach, CA 90813
Office: 562-435-2900
Fax 562-435-2933

RADIOGRAPHIC EXAMINATION REPORT

Report 2 of 3

TICKET NO.	0613
DATE	12/30/2009
P.O.	
JOB #	N/A

CUSTOMER/CONTACT	ALAMEDA TANK CO
LOCATION/ADDRESS	LOS ANGELES
UNIT/SYSTEM	Unit 89
ITEM DESCRIPTION	butt welds

MATERIAL	THICKNESS	QUANTITY	SURFACE CONDITION
C/S	std	25	AS WELDED

PROCEDURE	ACCEPTANCE STANDARD	ITEM TEMPERATURE
QCP-200	B31.3	AMBIENT

STAGE OF MANUFACTURE: [ ] INITIAL [ ] REPAIR [✓] FINAL

[✓] DWE/SWV [✓] SWE/SWV [ ] DWE/DWV

SFD: 6"

COMMENT:

SURFACE PREPARATION

TYPE OF FILM/QUANTITY	ISOTOPE USED	CI STRENGTH	EXPOSURES/TIME
1/60	IR192	40	36@30sec

WELD #	WELD SIZE	WALL	ACC	REJ	POR	SI	IP	NF	CR	IUC	EUC	CB	BT	LC	TI	UNIT	REMARKS
1	12"	std	✓													GLC-55789	
2	12"	std	✓													GLC-55789	
3	12"	std	✓													GLC-55789	
4	12"	std	✓													GLC-55789	
5	12"	std	✓													GLC-55789	
6	12"	std	✓													GLC-55789	
7	12"	std	✓													GLC-55789	
8	12"	std	✓													GLC-55789	
9	12"	std	✓													GLC-55789	
10	12"	std	✓													GLC-55789	
11	12"	std	✓													GLC-55789	
12	12"	std	✓													GLC-55789	
13	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
14	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
15	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
16	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
17	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
18	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
19	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90

LEGEND: ACC- ✓ =ACCEPTABLE, REJ-X=REJECTABLE, POR-POROSITY, SI-SLAG INCLUSION, IP-INCOMPLETE PENETRATION, NF-NON FUSION, CR-CRACK, IUC-INTERNAL UNDERCUT, EUC-EXTERNAL UNDERCUT, CB-CONCAVE BEAD, BT-BURN THROUGH, LC-LOW CAP, TI-TUNGSTEN INCLUSION

Jason Eberle Lvl II Level II

SIGNATURE OF CUSTOMER'S REPRESENTATIVE CERTIFIES TIME AND MATERIAL CORRECT

NAME, SIGNATURE, AND LEVEL

R&R NDE Services
1427 W. 14th Street
Long Beach, CA 90813
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Fax 562-435-2933

RADIOGRAPHIC EXAMINATION REPORT

Report 2 of 3

TICKET NO.	0613
DATE	12/30/2009
P.O.	
JOB #	N/A

CUSTOMER/CONTACT	ALAMEDA TANK CO
LOCATION/ADDRESS	LOS ANGELES
UNIT/SYSTEM	Unit 89
ITEM DESCRIPTION	butt welds

MATERIAL	THICKNESS	QUANTITY	SURFACE CONDITION
C/S	std	25	AS WELDED

PROCEDURE	ACCEPTANCE STANDARD	ITEM TEMPERATURE
QCP-200	B31.3	AMBIENT

STAGE OF MANUFACTURE: [ ] INITIAL [ ] REPAIR [✓] FINAL

COMMENT:

SURFACE PREPARATION

[✓] DWE/SWV [✓] SWE/SWV [ ] DWE/DWV

SFD: 6"

TYPE OF FILM/QUANTITY: 1/60

ISOTOPE USED: IR192

CI STRENGTH: 40

EXPOSURES/TIME: 36@30sec

WELD #	WELD SIZE	WALL	ACC	REJ	POR	SI	IP	NF	CR	IUC	EUC	CB	BT	LC	TI	UNIT	REMARKS
20	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
21	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
22	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90
23	2"	std	✓													GLC-55789	V0
	2"	std	✓													GLC-55789	V90

LEGEND: ACC-✓ =ACCEPTABLE, REJ-X=REJECTABLE, POR-POROSITY, SI-SLAG INCLUSION, IP-INCOMPLETE PENETRATION, NF-NON FUSION, CR-CRACK, IUC-INTERNAL UNDERCUT, EUC-EXTERNAL UNDERCUT, CB-CONCAVE BEAD, BT-BURN THROUGH, LC-LOW CAP, TI-TUNGSTEN INCLUSION

Jason Eberle Level II

SIGNATURE OF CUSTOMER'S REPRESENTATIVE CERTIFIES TIME AND MATERIAL CORRECT

NAME, SIGNATURE, AND LEVEL

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RADIOGRAPHIC EXAMINATION REPORT

Report 1 of 2

TICKET NO.	0673
DATE	1/7/2010
P.O.	
JOB #	N/A

CUSTOMER/CONTACT	ALAMEDA TANK CO
LOCATION/ADDRESS	LOS ANGELES
UNIT/SYSTEM	Unit 89
ITEM DESCRIPTION	butt welds

MATERIAL	THICKNESS	QUANTITY	SURFACE CONDITION
C/S	std	10	AS WELDED

PROCEDURE	ACCEPTANCE STANDARD	ITEM TEMPERATURE
QCP-200	B31.3	AMBIENT

STAGE OF MANUFACTURE: [ ] INITIAL [ ] REPAIR [✓] FINAL

COMMENT:

SURFACE PREPARATION

[ ] DWE/SWV [✓] SWE/SWV [ ] DWE/DWV

SFD	TYPE OF FILM/QUANTITY	ISOTOPE USED	CI STRENGTH	EXPOSURES/TIME
6"	1/30	IR192	40	10@30sec

WELD #	WELD SIZE	WALL	ACC	REJ	POR	SI	IP	NF	CR	IUC	EUC	CB	BT	LC	TI	UNIT	REMARKS
24	12"	std	✓													GLC-55789	
25	12"	std	✓													GLC-55789	
26	12"	std	✓													GLC-55789	
27	12"	std	✓													GLC-55789	
28	12"	std	✓													GLC-55789	
29	12"	std	✓													GLC-55789	
30	12"	std	✓													GLC-55789	
31	12"	std	✓													GLC-55789	
32	12"	std	✓													GLC-55789	
33	12"	std	✓													GLC-55789	

LEGEND: ACC- ✓ =ACCEPTABLE, REJ-X=REJECTABLE, POR-POROSITY, SI-SLAG INCLUSION, IP-INCOMPLETE PENETRATION, NF-NON FUSION, CR-CRACK, IUC-INTERNAL UNDERCUT, EUC-EXTERNAL UNDERCUT, CB-CONCAVE BEAD, BT-BURN THROUGH, LC-LOW CAP, TI-TUNGSTEN INCLUSION

Jason Eberle Lvl II Level II

SIGNATURE OF CUSTOMER'S REPRESENTATIVE CERTIFIES TIME AND MATERIAL CORRECT

NAME, SIGNATURE, AND LEVEL

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RADIOGRAPHIC EXAMINATION REPORT

Report 1 of 3

TICKET NO.	0612
DATE	12/29/2009
P.O.	
JOB #	N/A

CUSTOMER/CONTACT	ALAMEDA TANK CO
LOCATION/ADDRESS	LOS ANGELES
UNIT/SYSTEM	Unit 90
ITEM DESCRIPTION	butt welds

MATERIAL	THICKNESS	QUANTITY	SURFACE CONDITION
C/S	std	27	AS WELDED

PROCEDURE	ACCEPTANCE STANDARD	ITEM TEMPERATURE
QCP-200	B31.3	AMBIENT

STAGE OF MANUFACTURE: [ ] INITIAL [ ] REPAIR [✓] FINAL

COMMENT:

SURFACE PREPARATION

[✓] DWE/SWV [✓] SWE/SWV [ ] DWE/DWV

SFD	TYPE OF FILM/QUANTITY	ISOTOPE USED	CI STRENGTH	EXPOSURES/TIME
8"	1/97	IR192	40	49@30sec

WELD #	WELD SIZE	WALL	ACC	REJ	POR	SI	IP	NF	CR	IUC	EUC	CB	BT	LC	TI	UNIT	REMARKS
1	16"	std	✓													GLC-55790	
2	16"	std	✓													GLC-55790	
3	16"	std	✓													GLC-55790	
4	16"	std	✓													GLC-55790	
5	16"	std	✓													GLC-55790	
6	16"	std	✓													GLC-55790	
7	16"	std	✓													GLC-55790	
8	16"	std	✓													GLC-55790	
9	16"	std	✓													GLC-55790	
10	16"	std	✓													GLC-55790	
11	16"	std	✓													GLC-55790	
12	16"	std	✓													GLC-55790	
13	16"	std	✓													GLC-55790	
14	16"	std	✓													GLC-55790	
15	16"	std	✓													GLC-55790	
16	16"	std	✓													GLC-55790	
17	3"	std	✓													GLC-55790	
18	3"	std	✓													GLC-55790	
19	3"	std	✓													GLC-55790	
20	3"	std	✓													GLC-55790	
21	3"	std	✓													GLC-55790	
22	3"	std	✓													GLC-55790	
23	3"	std	✓													GLC-55790	
24	3"	std	✓													GLC-55790	
25	3"	std	✓													GLC-55790	
26	3"	std	✓													GLC-55790	
27	3"	std	✓													GLC-55790	

LEGEND: ACC- ✓ =ACCEPTABLE, REJ-X=REJECTABLE, POR-POROSITY, SI-SLAG INCLUSION, IP-INCOMPLETE PENETRATION, NF-NON FUSION, CR-CRACK, IUC-INTERNAL UNDERCUT, EUC-EXTERNAL UNDERCUT, CB-CONCAVE BEAD, BT-BURN THROUGH, LC-LOW CAP, TI-TUNGSTEN INCLUSION

Jason Eberle Lvl II

SIGNATURE OF CUSTOMER'S REPRESENTATIVE CERTIFIES TIME AND MATERIAL CORRECT

NAME, SIGNATURE, AND LEVEL

Level II

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RADIOGRAPHIC EXAMINATION REPORT

Report 2 of 2

TICKET NO.	0673
DATE	1/7/2010
P.O.	
JOB #	N/A

CUSTOMER/CONTACT	ALAMEDA TANK CO
LOCATION/ADDRESS	LOS ANGELES
UNIT/SYSTEM	Unit 90
ITEM DESCRIPTION	butt welds

MATERIAL	THICKNESS	QUANTITY	SURFACE CONDITION
C/S	std	6	AS WELDED

PROCEDURE	ACCEPTANCE STANDARD	ITEM TEMPERATURE
QCP-200	B31.3	AMBIENT

STAGE OF MANUFACTURE: [ ] INITIAL [ ] REPAIR [✓] FINAL

[ ] DWE/SWV [✓] SWE/SWV [ ] DWE/DWV

SFD: 8"

COMMENT:

SURFACE PREPARATION

TYPE OF FILM/QUANTITY	ISOTOPE USED	CI STRENGTH	EXPOSURES/TIME
1/24	IR192	40	6@30sec

WELD #	WELD SIZE	WALL	ACC	REJ	POR	SI	IP	NF	CR	IUC	EUC	CB	BT	LC	TI	UNIT	REMARKS
28	16"	std	✓													GLC-55790	
29	16"	std	✓													GLC-55790	
30	16"	std	✓													GLC-55790	
31	16"	std	✓													GLC-55790	
32	16"	std	✓													GLC-55790	
33	16"	std	✓													GLC-55790	

LEGEND: ACC- ✓ =ACCEPTABLE, REJ-X=REJECTABLE, POR-POROSITY, SI-SLAG INCLUSION, IP-INCOMPLETE PENETRATION, NF-NON FUSION, CR-CRACK, IUC-INTERNAL UNDERCUT, EUC-EXTERNAL UNDERCUT, CB-CONCAVE BEAD, BT-BURN THROUGH, LC-LOW CAP, TI-TUNGSTEN INCLUSION

Jason Eberle Lvl II Level II

SIGNATURE OF CUSTOMER'S REPRESENTATIVE CERTIFIES TIME AND MATERIAL CORRECT

NAME, SIGNATURE, AND LEVEL

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RADIOGRAPHIC EXAMINATION REPORT

Report 3of 3

TICKET NO.	0613
DATE	12/30/2009
P.O.	
JOB #	N/A

CUSTOMER/CONTACT	ALAMEDA TANK CO
LOCATION/ADDRESS	LOS ANGELES
UNIT/SYSTEM	Unit 91
ITEM DESCRIPTION	butt welds

MATERIAL	THICKNESS	QUANTITY	SURFACE CONDITION
C/S	std	34	AS WELDED

PROCEDURE	ACCEPTANCE STANDARD	ITEM TEMPERATURE
QCP-200	B31.3	AMBIENT

STAGE OF MANUFACTURE: [ ] INITIAL [ ] REPAIR [✔] FINAL

COMMENT:

SURFACE PREPARATION

[✔] DWE/SWV [✔] SWE/SWV [ ] DWE/DWV

SFD: 3"

TYPE OF FILM/QUANTITY: 1/88

ISOTOPE USED: IR192

CI STRENGTH: 40

EXPOSURES/TIME: 44@30sec

WELD #	WELD SIZE	WALL	ACC	REJ	POR	SI	IP	NF	CR	IUC	EUC	CB	BT	LC	TI	UNIT	REMARKS
1	6"	std	✔													GLC-55791	
2	6"	std	✔													GLC-55791	
3	6"	std	✔													GLC-55791	
4	6"	std	✔													GLC-55791	
5	6"	std	✔													GLC-55791	
6	6"	std	✔													GLC-55791	
7	6"	std	✔													GLC-55791	
8	6"	std	✔													GLC-55791	
9	6"	std	✔													GLC-55791	
10	6"	std	✔													GLC-55791	
11	6"	std	✔													GLC-55791	
12	6"	std	✔													GLC-55791	
13	6"	std	✔													GLC-55791	
14	6"	std	✔													GLC-55791	
15	6"	std	✔													GLC-55791	
16	6"	std	✔													GLC-55791	
17	6"	std	✔													GLC-55791	
18	6"	std	✔													GLC-55791	
19	6"	std	✔													GLC-55791	
20	6"	std	✔													GLC-55791	
21	6"	std	✔													GLC-55791	
22	6"	std	✔													GLC-55791	
23	3/4"	std	✔													GLC-55791	0
																	90
24	3/4"	std	✔													GLC-55791	0
																	90

LEGEND: ACC- ✔ =ACCEPTABLE, REJ-X=REJECTABLE, POR-POROSITY, SI-SLAG INCLUSION, IP-INCOMPLETE PENETRATION, NF-NON FUSION, CR-CRACK, IUC-INTERNAL UNDERCUT, EUC-EXTERNAL UNDERCUT, CB-CONCAVE BEAD, BT-BURN THROUGH, LC-LOW CAP, TI-TUNGSTEN INCLUSION

Jason Eberle Level II

SIGNATURE OF CUSTOMER'S REPRESENTATIVE CERTIFIES TIME AND MATERIAL CORRECT

NAME, SIGNATURE, AND LEVEL

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RADIOGRAPHIC EXAMINATION REPORT

Report 3of 3

TICKET NO.	0613
DATE	12/30/2009
P.O.	
JOB #	N/A

CUSTOMER/CONTACT	ALAMEDA TANK CO
LOCATION/ADDRESS	LOS ANGELES
UNIT/SYSTEM	Unit 91
ITEM DESCRIPTION	butt welds

MATERIAL	THICKNESS	QUANTITY	SURFACE CONDITION
C/S	std	34	AS WELDED

PROCEDURE	ACCEPTANCE STANDARD	ITEM TEMPERATURE
QCP-200	B31.3	AMBIENT

STAGE OF MANUFACTURE: [ ] INITIAL [ ] REPAIR [✔] FINAL

COMMENT:

SURFACE PREPARATION

[✔] DWE/SWV [✔] SWE/SWV [ ] DWE/DWV

SFD	TYPE OF FILM/QUANTITY	ISOTOPE USED	CI STRENGTH	EXPOSURES/TIME
3"	1/88	IR192	40	44@30sec

WELD #	WELD SIZE	WALL	ACC	REJ	POR	SI	IP	NF	CR	IUC	EUC	CB	BT	LC	TI	UNIT	REMARKS
25	3/4"	std	✔													GLC-55791	0
																	90
26	3/4"	std	✔													GLC-55791	0
																	90
27	3/4"	std	✔													GLC-55791	0
																	90
28	3/4"	std	✔													GLC-55791	0
																	90
29	3/4"	std	✔													GLC-55791	0
																	90
30	3/4"	std	✔													GLC-55791	0
																	90
31	3/4"	std	✔													GLC-55791	0
																	90
32	3/4"	std	✔													GLC-55791	0
																	90
33	3/4"	std	✔													GLC-55791	0
																	90

LEGEND: ACC- ✔ =ACCEPTABLE, REJ-X=REJECTABLE, POR-POROSITY, SI-SLAG INCLUSION, IP-INCOMPLETE PENETRATION, NF-NON FUSION, CR-CRACK, IUC-INTERNAL UNDERCUT, EUC-EXTERNAL UNDERCUT, CB-CONCAVE BEAD, BT-BURN THROUGH, LC-LOW CAP, TI-TUNGSTEN INCLUSION

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SIGNATURE OF CUSTOMER'S REPRESENTATIVE CERTIFIES TIME AND MATERIAL CORRECT

NAME, SIGNATURE, AND LEVEL