# ALFA LAVAL INC.
# DOCUMENTATION MANUAL
# FOR HEAT EXCHANGERS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **McClung Energy Services, LLC** | | | | **HEAT EXCHANGER ACE Model J54 Cooler** | | | |
| | | | | Customer Purchase Order No. | 0019620-03 | Serial No. | ACE1826322 |
| Sales Order No. | 0 | Manufacturer Order No. | ACE1826322 | Manufacturer: | Alfa Laval Inc<br>1201 S 9th Street<br>Broken Arrow, OK 74012 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
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# Section 1: General Operating, Maintenance and Reference Manual

# General Operating, Maintenance and Reference Manual

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# Contact Information

## Parts and Service

Email: ACE.PartsOrders@alfalaval.com
Phone: 918.505.3662

## General Sales & Customer Service

Email: ACE.Sales@alfalaval.com
Phone: 918.251.7477

# Introduction

The purpose of this manual is to provide recommendations for the receipt, operation and maintenance of Alfa Laval Inc. Air Cooled Exchanger (ACE) heat exchangers. Adherence to the general guidelines provided herein will help to ensure optimal mechanical and thermal performance over a maximized lifetime of the cooler while preserving operator and environmental safety.

As with any engineered product, any questions regarding the air cooler not addressed within this manual should be posed to Alfa Laval Inc. Air Cooled Exchangers, or through a qualified ACE representative.

All specific information communicated via the general arrangement drawing or mutually agreed contracts/specifications takes precedence over information in this document.

# Safety and Environment

It is imperative that a safety plan is established and observed prior to the operation of air-cooled heat exchangers. Safety guidelines are provided below, but it's the ultimate responsibility of the end user to observe any and all safety precautions as outlined by the operating company or installer's safety plan.

Always wear the proper personal protective equipment (PPE) when in the area of the air-cooled exchanger.

Never remove guards or protective equipment while the air-cooled exchanger is in operation. An established lock-out/tag-out procedure is preferred prior to any maintenance or removal of guarding.

Always disconnect electric fan motor(s) or disable engine ignition systems (disconnect battery) prior to performing maintenance, especially maintenance involving the cooler fan(s).

Avoid "hot work" without obtaining a hot work permit or observing the operating company's policy thereof.

Always use good, conservative and safe judgment when lifting cooler components. It is the user's responsibility to ensure all rigging and lifting equipment is sufficiently rated for the weight of the unit, but lifting plans are available from ACE upon request (charges may apply).

Always isolate, blow-down, vent, or purge gas sections prior to performing maintenance or work on the sections according to the operating company's procedures. **EXPOSURE TO TOXIC GASES OR LIQUIDS MAY RESULT IN INJURY OR DEATH.**

Always use OEM parts provided by Alfa Laval Inc. (ACE) to avoid any deviation from the design and operation intent, which could result an unsafe operating condition and/or voidance of unit warranty.

Never walk on surfaces not specified as walkways or labeled with an appropriate load bearing capacity. If unsure, assume that the surface is not safe for walking or loading, and contact Alfa Laval ACE for verification.

## Warranty and Potential Voidances

Alfa Laval Inc. Air Cooled Exchanger's standard warranty period begins upon the readiness to ship from the ACE factory and expires either 12 months from initial startup or 18 months from readiness to ship, whichever lapses first. Time spent in storage on Alfa Laval property does not extend the warranty of the equipment. For Alfa Laval ACE's full warranty statement, refer to our standard terms and conditions located at:

https://www.alfalaval.com/globalassets/documents/products/heat-transfer/finned-tube-air-heat-exchangers/alfa-laval-ace-terms-and-conditions.pdf

Extended warranty is available for purchase by contacting Alfa Laval ACE Sales or Service. For coolers that have shipped from ACE, an inspection by an Alfa Laval ACE Field Service technician is required prior to the extension of warranty.

The following items are not covered under Alfa Laval ACE's standard warranty:

Equipment damage resulting from improper lifting, loading, rigging, strapping, cinching or shipping

Unit lifting lugs are designed for the lifting of the equipment supplied only within ACE's scope. Accessory equipment attached to the air cooler, but not within ACE's scope, such as silencers, pipe racks, etc., may cause the cooler weight to exceed the capacity of the lifting lugs, resulting in equipment damage or danger to personnel.

Surface corrosion not associated with poor workmanship

Equipment failure or damage resulting from modifications without ACE's explicit approval

Equipment failure or damage resulting from operation outside of the cooler's rated temperature and pressure ranges

Equipment failure or damage resulting from mechanical or thermal shock

Removal of labels or decals installed for the purpose of reporting mechanical/thermal shock or operation outside of rated temperatures.

Unless otherwise specified and contractually agreed upon, ACE standard bundle internal cleaning is provided. Due to the geometry of welded box style headers, residual scale from the header plate and/or tubes, as well as moisture from the hydrotest process may reside in bundles at the time of shipment. It is the customer's responsibility to install startup strainers within the system to collect residual debris during the initial stages of equipment use. ACE is not responsible for damage to other equipment resulting from the omission of startup strainers.

Some deformation, or "laying over," of aluminum tube fins is typical, taken into consideration within ACE's thermal calculations, and not covered under ACE's standard warranty. Fin combs are available for purchase from ACE Parts and Service.

Readjustment or realignment of bolted and rotating components upon installation of the air cooler is normal, and is not covered under warranty as cooler loading, unloading, and transportation conditions often induce changes to bolted connections and rotating equipment alignment. See the startup and commissioning checklist for a list of connections and components requiring verification.

Breakage of fan mechanical components due to “hard starting” electric motors (this applies to all types of electric motor(s)) without utilization of soft starts, variable frequency drives, or V-speed magnetic drives is not covered under ACE’s standard warranty. These components include, but are not limited to, fan blades and hubs, shafts, and belts.

Horizontally mounted louvers are not rated for walking purposes. Damage to louvers as a result of walking or similar overload is not covered by ACE’s standard warranty.

Leaks discovered while pressure testing with a medium lighter than what the cooler bundles were designed for are not covered under warranty.

## Receipt and Unloading of Equipment

Review the packing list to ensure that any spare parts or items shipped loose due to dimensional or weight restrictions are accounted for. These items may be found apart from the cooler on separate skids or in crates, attached to the cooler skid/base, or inside of the cooler plenum. Contact ACE if additional instructions or guidance are needed.

Thoroughly inspect the air-cooled exchanger for damage incurred during transit or transfer between logistics equipment (trailers, vessels, etc.) and promptly note any damage on the bill of lading and present to the responsible party, who is typically the carrier, to ensure expedited filing of claims. Document any transport related damage via photographs. The following checklist has been provided as a method to ensure thorough inspection of received air coolers.

| General Cooler Receipt Inspection List | | | |
|---|---|---|---|
| | **N/A** | **Acceptable** | **Damaged** |
| **Structure** | | | |
| Structural Steel Integrity | | | |
| Sheet Metal Integrity | | | |
| **Fan Mechanicals** | | | |
| Fans | | | |
| Electric Motors | | | |
| Exposed Shafting | | | |
| Bearings | | | |
| Exposed Belts | | | |
| Sheaves | | | |
| **Louvers** | | | |
| Louver Frames, Blades | | | |
| Louver Actuators | | | |
| Louver Handles, Linkages | | | |
| **Bundles** | | | |
| Bundle Headers | | | |
| Finned Tubes | | | |
| Header Plugs | | | |
| Nozzle, Flange Integrity | | | |
| Process Flange Faces | | | |
| **Accessories** | | | |
| Lubrication Lines | | | |
| Vibration Switches | | | |
| Walkways, Ladders | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## Equipment Unloading and Handling

The air-cooled exchanger is to be lifted and unloaded using only lifting devices certified for the weight of the lifted product. Unless designed otherwise, ACE lifting lugs are intended for straight vertical lifts. Therefore, any lifting plan that

would result in bending of the lug(s) should not be used. Additionally, any bending of the unit or heat transfer section can result in tube leakage or structural damage. When lifting large units with multiple lifting points, spreader bars or chains shall be used to engage all lift points. Typical lifting plans are included in this manual. Note Fees may apply to requests for additional lifting details or information.

## Site Orientation

Installation and site orientation of the cooler are the sole responsibility of the purchaser, end user or contractor. Air-cooled heat exchangers must be placed with careful consideration given to surrounding objects, which may impede air-flow into the fan(s). The cooler must be placed at a suitable distance from other coolers and/or heat sources to avoid potential warm-air recirculation and degradation of cooler performance.

Coolers with vertically oriented fans are sensitive to wind direction and should be placed such that the prevailing winds at the site flow towards (into) the low pressure side of the fan. Coolers with fans forced to move air against the prevailing winds will likely experience less than desirable thermal performance, as well as an increased fan blade load and driver horsepower.

To mitigate air-flow starvation and recirculation issues when placing horizontal (ACE Model E) air-cooled heat exchangers adjacent to each other, the coolers may be elevated using piers or leg extensions. The height of elevation is specified such that air-flow “area” eliminated from the blocked sides is compensated for as height added to the cooler ends. Contact ACE for recommendations, if needed.

## Pre-Start Up Check and Inspection

Prior to the initial start up of the air cooler, a thorough inspection should be performed utilizing the supplied checklist, below. While this checklist is suited for ACE’s standard product offering, some coolers may include features and options that require additional attention prior to startup.

Failure to follow the pre-start up check and inspection may void the cooler’s warranty.

Cooler Serial Number(s):

Completed By:

Date:

| | Complete | N/A |
|---|---|---|
| **General** | | |
| All tools, construction materials, and ship-loose items have been removed from the cooler plenum and fan drive compartment(s). | | |
| Plenum access doors have been reinstalled and properly fastened. | | |
| | | |
| **Structure** | | |
| All structural bolting has been tightened or torqued. | | |
| | | |
| **Fan Mechanicals** | | |
| All fan blade clevis bolt torques, if applicable, have been verified. | | |
| Fan blade pitch has been verified and is within tolerance* of the design pitch reflected on the cooler specification sheet. [Tolerance 1 degree] | | |
| All fan hub and sheave bushing torques, if applicable, have been verified. | | |
| All fan tip clearances have been verified, are within specification, and are consistent. Fan ring adjustment (if available) or blade length adjustment may be necessary following transit. [Fan tip minimum clearance should be 5/8-7/8” with an average ¾”] | | |
| All vertical shafts, if applicable, are plumb within tolerance. [Tolerance 1 degree] | | |
| All inline shafts joined by flexible element couplings are within alignment tolerances. | | |
| All shaft bearing mounting bolts and collar set screw torques have been verified. | | |
| Bearings have been lubricated per manufacturer recommendations. | | |
| Bearing lubrication lines are completely filled with grease (if empty, disconnect from bearing grease zerk before filling). | | |
| All parallel shafts are within parallel shaft alignment tolerances. [Adjustable for belt tension, tolerance 1 degree] | | |
| All belt and sheave systems are within alignment tolerances. [Tolerance 1 degree] | | |
| Belt tension has been checked and is within specification. | | |
| Synchronous ("COG") style belts, if applicable, have been confirmed to ride true, centered on their sprockets, when tested by hand. | | |

| | | |
|---|---|---|
| Electric motor mounting bolts, if applicable, have been tightened or torqued. [Torqued 210-320 Ft-Lb] | | |
| Temporary shipping protection for electric motors and/or junction boxes, if applicable, has been removed. | | |
| Remove condensate drain plugs, if provided, from electric motors and other electrical components to drain any condensation that might have occurred during storage. If space heaters are furnished in electric motors, louver actuators, controls, etc., activate the space heaters and allow approximately 24 hours before starting equipment. | | |
| Electric motors, if applicable, have been bump tested to confirm correct polarity/fan rotation. | | |
| Vibration devices have been calibrated and tested to ensure driver annunciation when cooler vibration exceeds acceptable limits. | | |
| All associated drive guarding, including shaft guarding, fan guarding, and drive component guarding has been reinstalled and properly fastened. | | |
| Only after all above and applicable fan mechanical steps have been completed, the mechanical equipment may be cycled. Ensure that all personnel and equipment are away from the fan and fan drive area. Activate the fan driver and allow it to achieve rated speed. Check for vibration* and excessive noise. If vibration or excessive noise exists, decelerate the driver to a full stop and check for loose connections or insufficient clearance between moving parts. | | |
| | | |
| **Louvers** | | |
| Louvers have been fully cycled manually, by hand, to ensure that assembly is free of binding. If louvers are driven via pneumatic or electric actuators, disconnect actuators prior to manual cycle test. | | |
| Louver actuators, if applicable, have been plumbed and connected per actuator supplier recommendations. | | |
| | | |
| **Process Related** | | |
| If applicable, remove any temporary header restraining bolts or devices to allow for adequate thermal expansion. | | |
| If system hydrotest was required, the cooler bundles have been adequately drained, and if required, dried. | | |
| Startup strainers have been installed downstream of cooler to protect other sensitive process equipment from residual mill scale trapped due to complex header geometries. | | |
| Cooler bundles have been protected by properly rated pressure relief valves. | | |
| Control valves and/or equipment upstream of cooler bundle(s) have been configured such that the bundle(s) are not thermally shocked upon the introduction of hot fluid. | | |
| | | |

# Routine Maintenance Recommendations

As with any rotating equipment, reliability and longevity are heavily dependent upon proper maintenance. The Alfa Laval Inc. (ACE) Field Service team stands ready to partner with you to develop a customized maintenance plan and/or agreement to ensure maximum performance and uptime from your ACE air cooled heat exchanger.

Air cooled heat exchanger maintenance recommendations vary depending on the duty cycle, operating process, fluid quality and ambient conditions. Below are Alfa Laval Inc.'s minimum standard maintenance interval recommendations.

**Monthly**

- **Visual Inspection**; Visually inspect the cooler, paying most attention to fasteners and bundle tube or plug leaks.
- **Bearing Grease**; Ensure adequate bearing lubrication per manufacturer recommendations. Do not over-grease bearings. Over-lubrication is the most common cause of bearing failure.

**Quarterly**

Monthly maintenance plus…

- **Belt Tension**; If applicable, confirm that belt tension is within manufacturer recommended tolerances.
- **Rotation component fasteners**; Ensure all rotating equipment fasteners (including but not limited to bearing fasteners, fan hub/blade fasteners, shaft bushing fasters, or flexible coupling element fasteners) are adequately torqued per manufacturer recommendations.

**Annually**

Quarterly maintenance plus…

- **External cleaning**; In addition to general cleaning of cooler surfaces, clean finned tube external surfaces to ensure optimal thermal performance. Alfa Laval Inc. offers effective, biodegradable chemicals specifically designed for effective finned tube bundle cleaning.
- Fan maintenance; see Moore fan manual section 3.2 Annual Inspection or Crowley fan manual for additional information.

**Biennially (every two years)**

Annual maintenance plus…

- **Internal Cleaning**; Using industry accepted practices, such as hot flushing, lancing, etc., clean the internal surfaces of the tube bundle to ensure optimal

flow distribution and efficient transfer of heat from the fluid/gas to the tube wall. As with external cleaning, Alfa Laval Inc. offers effective, biodegradable chemicals specifically designed for tube bundle flushing.

**Bearing Lubrication**

Lubricate bearings in accordance with the bearing manufacturer's recommendations. Avoid over-lubrication of bearings, as this is the leading cause of premature bearing failure.

**Belt Tension**

Adjust belt drive tension in accordance with the tension stated on the GA. While sufficient belt tension is required to avoid belt slippage, over tensioning can impose excessive side loading on shaft or motor bearings.

**Plug Leaks**

Plugs are not sacrificial and may be re-used if not damaged. It is sound practice to mark plugs as they are removed such that they may be reinstalled into the same holes. This is particularly useful if the possibility exists of an oversize plug having been used following the repair of a threaded hole.

Alfa Laval Inc. (ACE) utilizes two different types of plugs in ASME code headers. Tapered plugs are used opposite 5/8" through 1" tubes unless specified otherwise by the customer. Shoulder plugs are used opposite 1.25" and 1.5" tubes, or when specified by the customer. In non-code sections, NPT plugs are used exclusively, unless specified otherwise by the customer. Tightening requirements are dependent upon plug size and can vary with the plug material.

Tapered Plugs

There is no standardized method of tightening an NPT threaded joint. Torque is not a good measure of how tight to make the tapered joint, because the quality of the threads and their taper affects the friction between the two thread surfaces. Also, most threaded joints are assembled with a thread sealant, either liquid or tape, and the type of sealant can affect the friction between the mating threads. ACE uses a liquid thread sealant in conjunction with an impact wrench which initially tightens nominally sized plugs to 150-200 ft-lbs. The plugs are tightened further as required to stop leakage, if any exists.

Shoulder Plugs

Shoulder plugs can be torqued to a set value, but since the goal of tightening the joint is to eliminate leaks, it is a good idea to torque to a lower value to start with, and then increase the torque if necessary until the gasket seals. Contact Alfa Laval Inc. (ACE)

for cooler specific assistance prior to the removal or tightening/torqueing of shoulder plugs.

## Tube Leaks

Tube Wall Leaks

A leak originating from a tube wall, typically from corrosion, is a problem solved best by isolating the tube from the media being cooled through the use of tapered seal pins. It's important to note that removing tubes from service will result in a decrease of cooling capacity and an increase in pressure drop. As a general rule of thumb, Alfa Laval Inc. (ACE) recommends seal-pinning no more than 5% of the tubes of one bundle, but it is ultimately up to the customer to decide what level of cooler performance degradation is acceptable. When the reduced performance of the section can no longer be tolerated, the section must be re-tubed. Seal pin and retube pricing is dependent on multiple variables. Please contact Alfa Laval Inc. (ACE) Parts and Service for pricing and availability.

Tube/Tube Sheet Joint Leaks

A leak that originates from the joint between the tube outside diameter of the tube and the tube sheet may be eliminated by re-rolling the subject tube using a tube expander. Please contact Alfa Laval Inc. (ACE) Parts and Service more information or Service availability.

## Storage Recommendations

It is imperative to properly store equipment that will not be immediately placed into service to avoid any potential damage to the equipment. Damage caused by improper storage is not covered under warranty claims.

Major concerns of equipment storage include, but are not limited to, condensation build up in the electric motors, bearing corrosion, and corrosion of unprotected machined surfaces and interior surfaces due to water ingress into the tube bundle. Drive belts are also susceptible to deterioration with extended storage.

Storage in harsh environmental conditions, such as coastal or tropical locations, significantly increases the potential for damage. The information provided below are recommendations only. The user is responsible for determining if special considerations or additional protection would be required. Alfa Laval's warranty does not cover deterioration due to corrosion or erosion of equipment after loading at our facility, or while stored on Alfa Laval property after completion and readiness to ship.

Short Term Storage Recommendations (Less than 6 months)

- Install plywood covers over the bundle and fan inlets.
- Cover electric motors and junction boxes with plastic shrink wrap and install desiccant bags where possible.
- Apply rust preventative coating on machined surfaces.
- Seal, cover, or plug all bundle/section openings.
- Rotate fan and motor shafts to circulate lubricants once every 30 days. Belts should be checked for dry rot or cracking.
- Store all actuators, switches, or sensors indoors.
- If storing between 3 and 6 months, reduce the tension on the belts (if applicable), by approximately one third of the design tension.

Long Term Storage Recommendations (Greater than 6 Months)

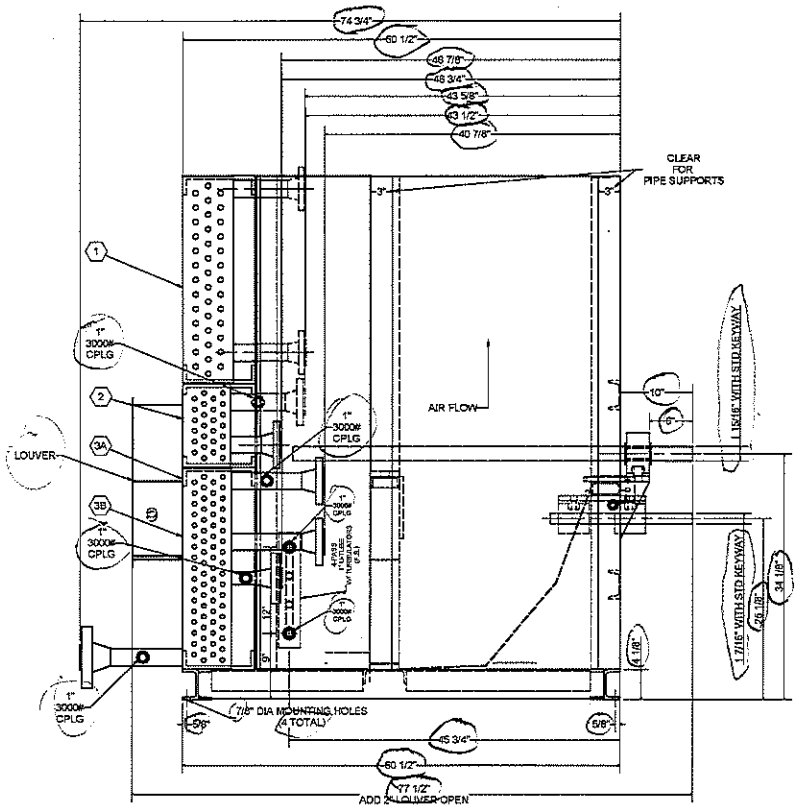
- Install plywood covers over the bundle and fan inlets.
- Remove electric motors and belts and store indoors. If equipped with space heaters, heaters should be utilized continuously.
- Apply rust preventative coating on machined surfaces, including belt sheaves or sprockets. Remove coating from sheaves and sprockets prior to startup.
- Seal, cover, or plug all bundle/section openings. Install blind flanges over process connections and fill bundle with an inert gas, such as nitrogen, to a nominal pressure between 15 and 20 psig. Check the inert gas pressure every 30 days, and always maintain positive pressure inside the bundle.
- Rotate fan and motor shafts to circulate lubricants once every 30 days. Automatic greasing systems should be considered.
- Store all actuators, switches, or sensors indoors.
- Prior to startup, all grease lines and bearings should be purged with new grease and any gear boxes should be drained and filled with new oil.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **HEAT EXCHANGER ACE Model J54 Cooler** | | | |
| | | | | Customer Purchase Order No. | 0019620-03 | Serial No. | ACE1826322 |
| Sales Order No. | 0 | Manufacturer Order No. | ACE1826322 | McClung Energy Services, LLC | | | |

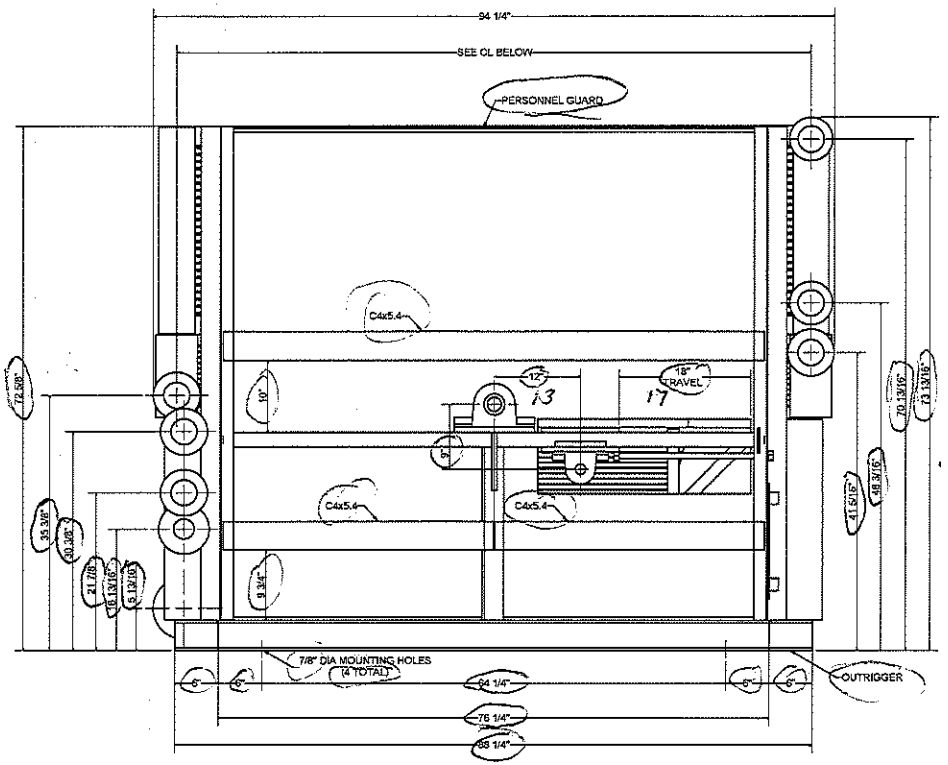
# Section 2: General Arrangement Drawings

1826322

DEN 1-29-19




SIDE ELEVATION




SHAFT END ELEVATION

Unit Tag Done 1/21/19

1/21/19 Tag Done

SEE CL BELOW - THESE DIMENSION (S) ARE SYMETRICAL ABOUT THE CENTER OF COOLER.

| FLAG | SERVICE | CL | LOUVERS | DESIGN PRESSURE | DESIGN TEMPERATURE | NOZZLES IN | NOZZLES OUT | OTHER NOZZLE | NC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | E/W | 57.75 | N/A | 100 PSI | 350 Deg F=20 Deg F | (1)2-150RF | (1)2-150RF | N/A | N/A |
| 2 | IC1 | 57.75 | MANUAL | 645 PSI | 350 Deg F=20 Deg F | (1)2-300RF | (1)2-300RF | N/A | N/A |
| 3A | IC2 | 85.75 | W/IC1 | 1257 PSI | 350 Deg F=20 Deg F | (1)2-600RF | (1)2-600RF | N/A | N/A |
| 3B | AC | 85.75 | W/IC1 | 1800 PSI | 350 Deg F=20 Deg F | (1)1.5-900RF | (1)2-900RF | N/A | N/A |

NOTES

1. WEIGHT: 3803 POUNDS
2. FINISH: ACE std prep, w/ one coat ACE std primer
3. FAN DRIVEN BY V-Belt Drive By Others
4. ASME CODE WITH NATIONAL BOARD ON IC1,IC2,AC,
5. PERSONNEL GUARD,

"The 2015 Edition of ASME Section VIII, Div 1 requires hydrostatic testing of headers/sections prior to coating application. However, ACE's standard practice requires that the initial application of header coating precedes hydrostatic testing. Through the approval of this drawing, you (the customer) acknowledge and approve of this deviation from current ASME Section VIII, Div 1 requirements."

UNIT: 1826301-27
TAG: 990010042-01
JOB: 18263

RPM= 848
HP= 7 PER FAN
BLADE ANGLE= 37

# AIR COOLED EXCHANGERS

SCALE: 1:1 (FIT TO PLOT) | ACE MODEL J54-7 | DRAWN BY: AJD
DATE: 10/30/2018 | CHECKED BY:
CUSTOMER: McClung Energy | P.O: 0020014-01

| | BY | DATE | DESCRIPTION | CK'D | DRAWING NUMBER | REV |
|---|---|---|---|---|---|---|
| 0 | CK | 10/29/18 | SEE 17137 FOR STRUCT | | 18263 -C | 0 |

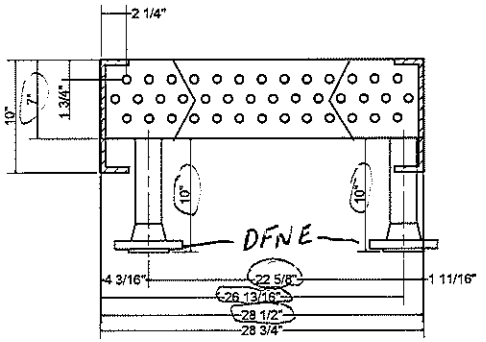
| ITEM | DESCRIPTION | |
|---|---|---|
| TUBE AND PLUG | STEEL RMT 1/2" X 7" x 5" x 28 1/2" | |
| END PLATE | SA36 3/8" x 5 3/4" x 3 3/4" | |
| WRAPPER | N.A. | |
| PASS PLATE | 3/16 IN. THK C.S. | |
| NOZZLE IN/OUT | 2"-150RF XH , SA-105/ | 2"-150RF XH , SA-105 |
| PIPE SIZE IN/OUT | 2" XH , SA-106-GR B/ | 2" XH , SA-106-GR B |
| DESIGN PRESS (PSI) | 100 | |
| HYDRO TEST PRESS (PSI) | 130 | |
| DESIGN TEMP (DEG F) | 350/-20 IMPACT EXEMPT PER UG-20(f) | |
| TUBES | 40 - 3/4" Dia x 0.06"MW x 7'-0" LG. SA214(WLD) | |
| FIN STRIP BACK | STD | |
| PLUGS | TAPERED 3/4" NPT X 3/4" LG. SAE TYPE | |
| GROOVE TUBE SHEET | YES - (SINGLE GROOVE) | |
| A.S.M.E. CODE STAMP | NO | |
| | | |
| HEAT TREAT | NO | |
| RADIOGRAPH (RT) | NO | |
| ULTRASONIC TEST (UT) | NO | |
| DYE-PENETRANT (PT) | STD | |
| CORROSION ALLOWANCE | NONE | |
| SIDE FRAME | C 10 @15.3# x 6'-10 5/8" LG. | |
| C.R.N. | NONE | |
| NAT'L BOARD NO. | NO | |
| OTHER NOZZLE | N/A | |
| OTHER PIPE SIZE | N/A | |

SERVICE: EJW

FLAG: (1)

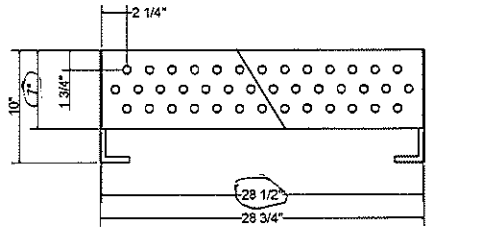
NOTES:

EJW




BACK HEADER
(TUBE FACE)
2 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.

EJW




FRONT HEADER
(PLUG FACE)
1 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.

WELD PROCEDURE

FINISH: SEE THE JOB ORDER

UNIT: 1826301-27
TAG: 990010042-01
JOB: 18263

ACE AIR COOLED EXCHANGER, INC.

| | | | |
|---|---|---|---|
| SCALE: 1:1 (FIT TO PLOT) | ACE MODEL J54-7 | DRAWN BY: AID | |
| DATE: 7/10/2017 | | CHECKED BY: | |

CUSTOMER McClung Energy

| | BY | DATE | DESCRIPTION | CK'D | DRAWING NUMBER | REV |
|---|---|---|---|---|---|---|
| | | | | | 18263 -H1 | |

NB
12-F1,1B

TP M835N(V)
END NV488N(A5)
WRAP NV488N(A5)
Pipe TJC(1)
Flng H3150(H)
Cplg 39J(H)

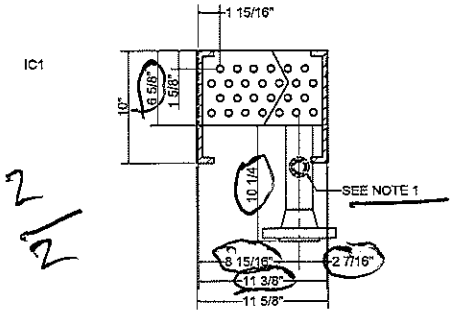
| ITEM | DESCRIPTION | |
|---|---|---|
| TUBE AND PLUG | SA-516-70 7/8" x 6 5/8" x 11 3/8" | |
| END PLATE | SA-516-70 1/2" x 5 3/8" x 3 3/4" | |
| WRAPPER | SA-516-70 1/2" x 3 3/4" x 11 3/8" | |
| PASS PLATE | SA-516-70 1/4 IN. THK | |
| NOZZLE IN/OUT | 2"-300RF XH , SA-105/ | 2"-300RF XH , SA-105 |
| PIPE SIZE IN/OUT | 2" XH , SA-106-GR B/ | 2" XH , SA-106-GR B |
| DESIGN PRESS (PSI) | 645 | |
| HYDRO TEST PRESS (PSI) | 839 | |
| DESIGN TEMP (DEG F) | 350/-20 IMPACT EXEMPT PER UG-20(f) | |
| TUBES | 26 - 5/8" Dia x 0.06"MW x 7'-0" LG. SA214(WLD) | |
| FIN STRIP BACK | STD | |
| PLUGS | TAPERED 1/2" NPT X 3/4" LG. SA-105 | |
| GROOVE TUBE SHEET | NO | |
| A.S.M.E. CODE STAMP | YES (PER SEC VIII, DIV.1, 2017 ED. APPENDIX 13) | |
| | | |
| HEAT TREAT | NO | |
| RADIOGRAPH (RT) | NO | |
| ULTRASONIC TEST (UT) | NO | |
| DYE-PENETRANT (PT) | STD | |
| CORROSION ALLOWANCE | NONE | |
| SIDE FRAME | 10 IN. FMD C W/1.5 IN. LEG X 0.1793 IN. THICK x 6'-9 7/8" LG. | |
| C.R.N. | NONE | |
| NAT'L BOARD NO. | YES IC-T496 | |
| OTHER NOZZLE | N/A | |
| OTHER PIPE SIZE | N/A | |

SERVICE: IC1

FLAG: (2)

NOTES:

1. 1-3000# THREDOLET, SA-105, REQUIRED CPLG ON INLET NOZZLE AS NOTED ON DRAWING FOR IC1



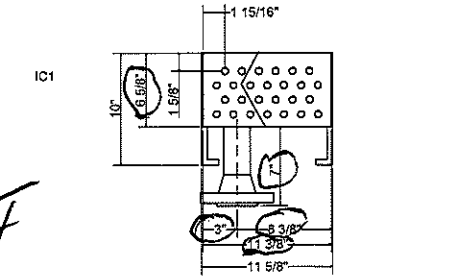

2/2

BACK HEADER
(TUBE FACE)

1 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.

NB
12, F1,1B

TP M835N(V)
END NV488N(TW)
WRAP NV488N(W)
Pipe TJC(1)
Flng H3150(H)




1/2

FRONT HEADER
(PLUG FACE)

1 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.

WELD PROCEDURE

MIG-FC-P1 END PLATES, PIPE TO FLANGES,PIPE AND COUPLINGS TO HEADERS.

MIG-FC-AW-P1 LONG SEAMS.

UNIT: 1826301-27
TAG: 990010042-01
JOB: 18263

AIR COOLED EXCHANGER, INC.

| | | | |
|---|---|---|---|
| SCALE: 1:1 (FIT TO PLOT) | ACE MODEL J54-7 | DRAWN BY: AID | |
| DATE: 10/30/2019 | | CHECKED BY: | |

CUSTOMER McClung Energy

| | BY | DATE | DESCRIPTION | CK'D | DRAWING NUMBER | REV |
|---|---|---|---|---|---|---|
| | | | | | 16263 -H2 | |

| ITEM | DESCRIPTION | |
|---|---|---|
| TUBE AND PLUG | SA-516-70 NORM 1 5/8" x 6 3/4" x 27 7/8" | |
| END PLATE | SA-516-70 NORM 3/4" x 5 1/4" x 2 3/4" 1 | |
| WRAPPER | SA-516-70 NORM 3/4" x 2 3/4" x 27 7/8" 1 | |
| PASS PLATE | SA-516-70 NORM 1/4 IN. THK | |
| NOZZLE IN/OUT | 2"-600RF XH , SA-105/ | 2"-600RF XH , SA-105 |
| PIPE SIZE IN/OUT | 2" XH , SA-106-GR B/ | 2" XH , SA-106-GR B |
| DESIGN PRESS (PSI) | 1287 | |
| HYDRO TEST PRESS (PSI) | 1673 | |
| DESIGN TEMP (DEG F) | 350/-20 IMPACT EXEMPT PER UG-20(f) | |
| TUBES | 34 - 5/8" Dia x 0.06"MW x 7'-0" LG. SA214(WLD) | |
| FIN STRIP BACK | STD | |
| PLUGS | TAPERED 1/2" NPT X 3/4" LG. SA-105 | |
| GROOVE TUBE SHEET | NO | |
| A.S.M.E. CODE STAMP | YES (PER SEC VIII, DIV.1, 2017 ED. APPENDIX 13) | |
| | | |
| HEAT TREAT | NO | |
| RADIOGRAPH (RT) | NO | |
| ULTRASONIC TEST (UT) | NO | |
| DYE-PENETRANT (PT) | STD | |
| CORROSION ALLOWANCE | NONE | |
| SIDE FRAME | C 10 @15.3# x 6'-8 3/8" LG. | |
| C.R.N. | NONE | |
| NAT'L BOARD NO. | YES 16791 | |
| OTHER NOZZLE | N/A | |
| OTHER PIPE SIZE | N/A | |

SERVICE: IC2 2

FLAG: 3A

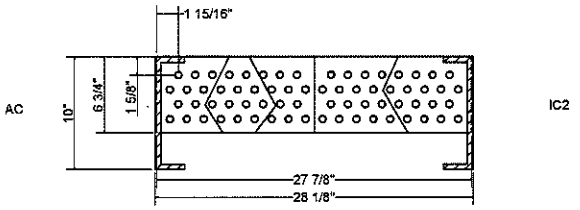
| ITEM | DESCRIPTION | |
|---|---|---|
| TUBE AND PLUG | COMBINED | |
| END PLATE | COMBINED | |
| WRAPPER | | |
| PASS PLATE | SA-516-70 NORM 1/4 IN. THK | |
| NOZZLE IN/OUT | 1.5"-900RF XH , SA-105/ | 2"-900RF XH , SA-105/ |
| PIPE SIZE IN/OUT | 1.5" XH , SA-106-GR B/ | 2" XH , SA-106-GR B/ |
| DESIGN PRESS (PSI) | 1800 | |
| HYDRO TEST PRESS (PSI) | 2340 | |
| DESIGN TEMP (DEG F) | 350/-20 IMPACT EXEMPT PER UG-20(f) | |
| TUBES | 34 - 5/8" Dia x 0.06"MW x 7'-0" LG. SA214(WLD) | |
| FIN STRIP BACK | STD | |
| PLUGS | TAPERED 1/2" NPT X 3/4" LG.SA-105 | |
| GROOVE TUBE SHEET | YES - (DOUBLE GROOVE) | |
| A.S.M.E. CODE STAMP | YES (PER SEC VIII, DIV.1, 2017 ED. APPENDIX 13) | |
| | | |
| HEAT TREAT | NO | |
| RADIOGRAPH (RT) | NO | |
| ULTRASONIC TEST (UT) | NO | |
| DYE-PENETRANT (PT) | STD | |
| CORROSION ALLOWANCE | NONE | |
| SIDE FRAME | COMBINED | |
| C.R.N. | NONE | |
| NAT'L BOARD NO. | YES 16795 | |
| OTHER NOZZLE | N/A | |
| OTHER PIPE SIZE | N/A | |

SERVICE: AC 2

FLAG: 3B

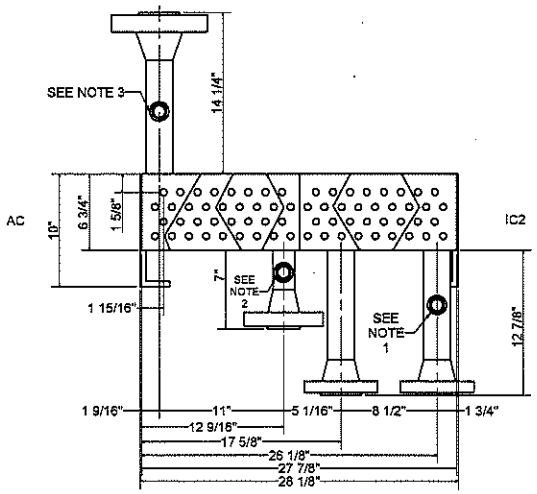
NOTES:

1. 1-3000# THREDOLET, SA-105, REQUIRED CPLG ON INLET NOZZLE AS NOTED ON DRAWING FOR IC2
2. 1-3000# THREDOLET, SA-105, REQUIRED CPLG ON INLET NOZZLE AS NOTED ON DRAWING FOR AC
3. 1-3000# THREDOLET, SA-105, REQUIRED CPLG ON OUTLET NOZZLE AS NOTED ON DRAWING FOR AC




BACK HEADER
(TUBE FACE)

ON SERVICE IC2, 1 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.ON SERVICE AC, 2 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.SERVICE DIVIDER REQUIRED AT TUBE FACE 9




FRONT HEADER
(PLUG FACE)

ON SERVICE IC2, 2 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.ON SERVICE AC, 3 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.SERVICE DIVIDER REQUIRED AT TUBE FACE 9

WELD PROCEDURE

MIG-FC-P1 END PLATES, PIPE TO FLANGES,PIPE AND COUPLINGS TO HEADERS.

MIG-FC-AW-P1 LONG SEAMS.

UNIT: 1826301-Z7
TAG: 990010042-01
JOB: 16263

**AIR COOLED EXCHANGER, INC.**

| | | | |
|---|---|---|---|
| SCALE: 1:1 (FIT TO PLOT) | ACE MODEL J54-7 | DRAWN BY: AID | |
| DATE: 10/29/2018 | | CHECKED BY: | |

CUSTOMER McClung Energy

| | BY | DATE | DESCRIPTION | CK'D | DRAWING NUMBER | REV |
|---|---|---|---|---|---|---|
| 1 | CK | 11/8/18 | REV WRAPPER & END PLATE | | 18263 -H3 | 2 |
| 2 | CK | 12/3/18 | REV SERVICE | | | |

SEE NEXT PAGE

11.27.18 AB

TP NU492N(R)
END NU496N(A5)
WRAP NU496N Q

| ITEM | DESCRIPTION | |
|---|---|---|
| TUBE AND PLUG | SA-516-70 NORM 1 5/8" x 6 3/4" x 27 7/8" | |
| END PLATE | SA-516-70 NORM 5/8" X 5 1/4" x 1 3/4" | |
| WRAPPER | SA-516-70 NORM 5/8" x 1 3/4" x 27 7/8" | |
| PASS PLATE | SA-516-70 NORM 1/4 IN. THK | |
| NOZZLE IN/OUT | 2"-600RF XH , SA-105/ | 2"-600RF XH , SA-105 |
| PIPE SIZE IN/OUT | 2" XH , SA-106-GR B/ | 2" XH , SA-106-GR B |
| DESIGN PRESS (PSI) | 1287 | |
| HYDRO TEST PRESS (PSI) | 1673 | |
| DESIGN TEMP (DEG F) | 350/-20 IMPACT EXEMPT PER UG-20(f) | |
| TUBES | 34 - 5/8" Dia x 0.06"MW x 7'-0" LG. SA214(WLD) | |
| FIN STRIP BACK | STD | |
| PLUGS | TAPERED 1/2" NPT X 3/4" LG. SA-105 | |
| GROOVE TUBE SHEET | NO | |
| A.S.M.E. CODE STAMP | YES (PER SEC VIII, DIV.1, 2017 ED. APPENDIX 13) | |
| | | |
| HEAT TREAT | NO | |
| RADIOGRAPH (RT) | NO | |
| ULTRASONIC TEST (UT) | NO | |
| DYE-PENETRANT (PT) | STD | |
| CORROSION ALLOWANCE | NONE | |
| SIDE FRAME | C 10 @15.3# x 6'-8 3/8" LG. | |
| C.R.N. | NONE | |
| NAT'L BOARD NO. | YES | |
| OTHER NOZZLE | N/A | |
| OTHER PIPE SIZE | N/A | |

SERVICE: IC2

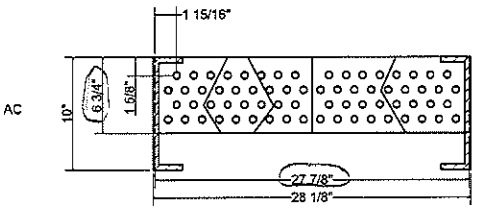
FLAG: 3A

| ITEM | DESCRIPTION | |
|---|---|---|
| TUBE AND PLUG | COMBINED | |
| END PLATE | COMBINED | |
| WRAPPER | | |
| PASS PLATE | SA-516-70 NORM 1/4 IN. THK | |
| NOZZLE IN/OUT | 1.5"-900RF XH , SA-105/ | 2"-900RF XH , SA-105/ |
| PIPE SIZE IN/OUT | 1.5" XH , SA-106-GR B/ | 2" XH , SA-106-GR B/ |
| DESIGN PRESS (PSI) | 1800 | |
| HYDRO TEST PRESS (PSI) | 2340 | |
| DESIGN TEMP (DEG F) | 350/-20 IMPACT EXEMPT PER UG-20(f) | |
| TUBES | 34 - 5/8" Dia x 0.06"MW x 7'-0" LG. SA214(WLD) | |
| FIN STRIP BACK | STD | |
| PLUGS | TAPERED 1/2" NPT X 3/4" LG.SA-105 | |
| GROOVE TUBE SHEET | YES - (DOUBLE GROOVE) | |
| A.S.M.E. CODE STAMP | YES (PER SEC VIII, DIV.1, 2017 ED. APPENDIX 13) | |
| | | |
| HEAT TREAT | NO | |
| RADIOGRAPH (RT) | NO | |
| ULTRASONIC TEST (UT) | NO | |
| DYE-PENETRANT (PT) | STD | |
| CORROSION ALLOWANCE | NONE | |
| SIDE FRAME | COMBINED | |
| C.R.N. | NONE | |
| NAT'L BOARD NO. | YES | |
| OTHER NOZZLE | N/A | |
| OTHER PIPE SIZE | N/A | |

SERVICE: AC

FLAG: 3B

NOTES:
1. 1-3000# THREDOLET, SA-105, REQUIRED CPLG ON INLET NOZZLE AS NOTED ON DRAWING FOR IC2
2. 1-3000# THREDOLET, SA-105, REQUIRED CPLG ON INLET NOZZLE AS NOTED ON DRAWING FOR AC
3. 1-3000# THREDOLET, SA-105, REQUIRED CPLG ON OUTLET NOZZLE AS NOTED ON DRAWING FOR AC



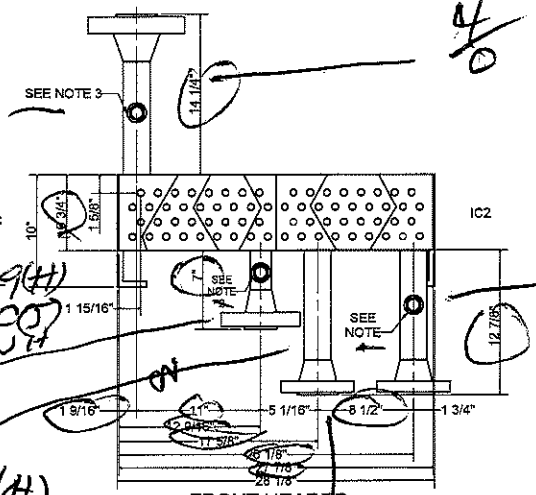

BACK HEADER
(TUBE FACE)

ON SERVICE IC2, 1 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.ON SERVICE AC, 2 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.SERVICE DIVIDER REQUIRED AT TUBE FACE 9

TP NU352N(R)
END NU496N(14)
WRAP NU496N Q
PIPE →
F/NG
C/G

4/0

#154946N(H)
TJC(J)
39J(H)




NO1729(H)
TCOO
39JH

4/0

12.19.18 B03934(H)
TJC(J)

FRONT HEADER
(PLUG FACE)

ON SERVICE IC2, 2 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.ON SERVICE AC, 3 CROSSFLOW PASSPLATE PASSPLATE REQUIRED.SERVICE DIVIDER REQUIRED AT TUBE FACE 9

WELD PROCEDURE
MIG-FC-P1 END PLATES, PIPE TO FLANGES,PIPE AND COUPLINGS TO HEADERS.
MIG-FC-AW-P1 LONG SEAMS.

4/4

UNIT: 1826301-27
TAG: 990010042-01
JOB: 18263

AIR COOLED EXCHANGER, INC.

| | | | |
|---|---|---|---|
| SCALE: 1:1 (FIT TO PLOT) | ACE MODEL J54-7 | DRAWN BY: AID | |
| DATE: 10/30/2018 | | CHECKED BY: | |

CUSTOMER McClung Energy

| | BY | DATE | DESCRIPTION | CK'D | DRAWING NUMBER | REV |
|---|---|---|---|---|---|---|
| | | | | | 18263 -H3 | |

| Title: QC Inspection Plan with Structure/Assembly Checklist | | |
|---|---|---|
| Author: Randy Hall | Doc. No.: 30008 | Revision: # 1 |
| Department: Quality | | Page 3 of 5 |

| Job Number: **18263022 Rev.0** | | Date Started: **10/30/2018** | Customer: **McClung Energy** |
|---|---|---|---|
| Model #: **J54-7** | Bay: **5** | Salesman: | Outside Inspector:<br>PO # **0020014-01** |

| Item | Inspection Points (All rejected parts see notes page; If not circled then item not applicable.) | | | | QC | Date |
|---|---|---|---|---|---|---|
| Structure | Fitup (OK) / Reject | Weld (OK) / Reject | Clean (OK) / Reject | | | 1-29-19 |
| Side Frames | Fitup (OK) / Reject | Weld (OK) / Reject | Clean (OK) / Reject | | | 1-29-19 |
| Recorded Air | Air Temp*= | Humidity = | Dupoint= | (N/A) | — | — |
| Blast Profiles of Structure | #1= | #2= | #3= | Avg= (N/A) | — | — |
| Paint Primer per Spec.(Mils) | Actual= | Average= | | (N/A) | — | — |
| Paint Color | Product No.= Primer | | Mils= | | DR | 1/30 |

| Make sure you have paint report! RH 6/1/17 | EJW Front | EJW Back | IC1 Front | IC1 Back | IC2 / AC Front | IC2 / AC Back | Front | Back | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Header fitup,Internals/final | | | | | | | N/A | N/A | | 1-29-19 |
| Flanges fitup/weld,Clean | | | | | | – | N/A | N/A | | 1-29-19 |
| Flange 2Hole, Pitch/ Size | – | | | | | – | N/A | N/A | | 1-29-19 |
| Flange Face/Location | – | | | | | – | N/A | N/A | | 1-29-19 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CRN's | Yes | **No** | Sect. 1 — | Sect. 2 — | Sect. 3 — | Sect. 4 **N/A** | | |
| ASME/N.B.# | **Yes** | No | Sect. 1 — | Sect. 2 (U) 16746 | Sect. 3 16747, 16748 | Sect. 4 **N/A** | | |
| PED | Yes | **No** | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yellow Sheet Sign off Sheet | **Print sheet send to Carl, QC then AI for sign off | | | | | | | | | | | | | 1/21 |
| U1A | **Check all properties and QC Sign and AI Sign | | | | | | | | | | | | | 1/21 |
| Hydro Test w/Certification | EJW | | IC1 | | IC2 / AC | | | | | | | | DR | 1/30 |
| Water / Oil **X1.3** | (OK) | REJECT | (OK) | REJECT | (OK) | REJECT | OK | REJECT | | | | | | 1/21 |
| Hydro Test Gauges # | 41111171 | | 1500-3 | | 30518-1500-10 | | | | | | | | DR | 1/30 |
| Hydro Chart Recorder # | — | | — | | — | | | | | | | | — | — |
| Air Test/Certification | — | | — | | — | | | | | | | | — | — |
| Calibration Record | Chart Machine ☐ | | Hydro Gauges ☐ | | Welding Machine ☐ | | | | | | | | — | — |
| Fin Strip Back (1.5 times the thickness of the tube sheet) | Max: | | Average dim: | | | | | | | | | | — | — |

| **Tags Created, Reviewed & Scanned | Section 1 | | Section 2 | | Section 3 | | Section 4 | | ~~Water~~ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Yes) | No | (Yes) | No | (Yes) | No | Yes | No | Yes | No | | 1/21 |
| **MTR's (Job Folder) | Yes | (No) | Yes | (No) | Yes | (No) | Yes | No | Yes | No | | |
| "C" Drawing Dim. Check | **Check all Dimensions and read all notes, rev number, UG99 note...etc. | | | | | | | | | | | 1-29-19 |

| Weld Map (Put In Job Folder) Y (N) | Heat Map (Put In Job Folder) Y (N) | Hardness (Put In Job Folder) Y (N) | — | — |
|---|---|---|---|---|
| NDE PT (X) MT ☐ RT ☐ UT ☐ PMI ☐ HT ☐ | | | | 1/21 |
| Tubes C.S. (X) 304ss ☐ 316ss ☐ Copan Coating ☐ Embedded ☐ Extruded ☐ L-Ft (X) Turbulators ☐ Welded (X) Seamless ☐ | | | | 1/21 |
| Tube to Tube Sheet Weld per Job Order Yes (No) | Heat Coil / Oil Tubes per Job Order Yes (No) | | — | — |

**Sheet 1 approved by quality inspector:** Randy Hall **Date:** 1/30/19

| Title: QC Inspection Plan with Structure/Assembly Checklist | | |
|---|---|---|
| Author: Randy Hall | Doc. No.: 30008 | Revision: # 1 |
| Department: Quality | | Page 4 of 5 |

| Job Number: **18263022 Rev.0** | | Date Started: **10/30/2018** | Customer: **McClung Energy** |
|---|---|---|---|
| Model #: **J54-7** | Bay: **5** | Salesman: | Outside Inspector: |
| | | | PO # **0020014-01** |

| Item | Inspection Points (All rejected parts see notes page; If not circled then item not applicable.) | | | | | QC | Date |
|---|---|---|---|---|---|---|---|
| Louvers | Fail Open ☒ | Fail Close ☐ | Witness louver test ☐ | Manual ☒ | Test @ PSI | JH | 1-29-19 |
| Actuators | Mounted ☒ | Shipped Loose ☐ | N/A ☐ | | | JH | 1-29-19 |
| Vibration Switch | Mounted ☐ | Shipped Loose ☒ | N/A | | | DR | 1/30/19 |
| Temp Controllers | Mounted ☐ | Shipped Loose ☐ | N/A ☒ | | | — | — |
| Guards- Meets OSHA | Check for Hail, Fan Guards | | N/A ☐ | | | JH | 1-29-19 |
| Bugscreens | Inside Unit ☐ | On Pallet ☐ | N/A ☒ | | | — | — |
| LEGS, Bracing & Bolts | Mounted ☐ | Shipped Loose ☐ | N/A ☒ | | | — | — |
| Extra Parts | Fan Belts ☐ | Hard ware ☐ | Blind Flanges ☐ | N/A ☒ | | — | — |
| Bearings (check off each box) | Check Set Screws ☒ | Bolts ☒ | Zerks ☒ | Lube Lines ☒ | Location ☒ | JH | 1-29-19 |
| Shaft (s) | Level ☒ | Projection ☒ | Alignment ☒ | Multiple shafts write findings on notes | | JH | 1-29-19 |
| Sheave & Belts | Size and number of belts: | | | | N/A ☒ | — | — |
| Fan Installation | Check all set screws and bolts ☒ | Fan Blades Pitch **37*** | No. of Blades: **6** | | | JH | 1-29-19 |
| | Findings: PITCH VERIFIED DURING ASSEMBLY | Tip Clearance: less than or equal108"=1/4"-1/2" 108"-132"=1/4"-5/8", Greater than 132"= ¼"- ¾" | | | | JH | 1-29-19 |
| Idler Shaft | Level ☒ | Projection: 10" - 6" | N/A ☒ JH | | | JH | 1-29-19 |
| **Motor Run Test | Yes (No) | Motor Serial # | If yes, see run test doc. in job folder. | | | — | — |
| | VIBRATION ☐ | AIR FLOW ☐ | SOUND ☐ | | | — | — |
| Paint of Coating (Final) | Paint ☒ | Galvanized ☐ | Final Paint Mils: 3.5 | | | DR | 1/30/19 |
| Special Markings | Yes No (N/A) | | | | | — | — |
| Green Tag | Installed on unit ☒ | Scanned in Job Folder ☒ | | | | DR | 1/30/19 |

**NOTES:**

1. **denotes documents that are standard for every job.

1" Serpentine w/ Turbulators

1- KimRay T12 T.C.

Approved for shipment by Quality Inspector: Darrell Rigg Date: 1/30/19

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **HEAT EXCHANGER ACE Model J54 Cooler** | | | |
| | | | | Customer Purchase Order No. | 0019620-03 | Serial No. | ACE1826322 |
| Sales Order No. | 0 | Manufacturer Order No. | ACE1826322 | McClung Energy Services, LLC | | | |

# Section 3: Performance Datasheet

Alfa Laval Inc.
Air Cooled Exchangers
1201 S. 9th Street – Broken Arrow, Oklahoma 74012
Phone: 918.251.7477
Email: ACE.sales@alfalaval.com

***COOLER PERFORMANCE SPECIFICATION IS SHOWN FOR ONE BAY. (1) BAYS REQUIRED***

| | | | |
|---|---|---|---|
| **CUSTOMER** | McClung Energy | **PROPOSAL NUMBER** | 18263R1.dat |
| **REFERENCE** | Standard J54-7{CAT 3306 NA 145HP 10.5:1 STD 1800 rpm} | **DATE** | 10/25/2018 |
| **MODEL** | J54-7 | **PAGE** | 1 |

***PERFORMANCE OF ONE UNIT***

| SERVICE | EJW | IC1 | IC2 | AC |
|---|---|---|---|---|
| **FLOW** | 45.0GPM | 0.75MMSCFD | 1.21MMSCFD | 0.81MMSCFD |
| **FLUID** | 50%GLY | .65 | .65 | .65 |
| **TEMPERATURE IN F** | 190.0 | 264.0 | 254.0 | 254.0 |
| **TEMPERATURE OUT F** | 164.2 | 130.0 | 130.0 | 120.0 |
| **INLET PRESSURE PSIG** | | 203.60 | 707.28 | 810.00 |
| **PRESSURE LOSS PSI** | 3.79 | 3.92 | 3.80 | 5.00 |
| **DUTY, BTU/HR** | 515520.0 | 121393.2 | 191315.2 | 141118.9 |
| **CORRECTED MTD, F** | 48.3 | 57.5 | 51.8 | 45.0 |
| **OVER-ALL U BTU/(hr*sqft*F)** | 201.5 | 73.5 | 98.3 | 83.6 |
| **FOULING** | 0.000500 | 0.002000 | 0.002000 | 0.002000 |
| **BARE SURFACE FT2** | 53 | 29 | 38 | 38 |
| **TOTAL SURFACE FT2** | 1267 | 457 | 597 | 597 |

***CONSTRUCTION***

| | | | | |
|---|---|---|---|---|
| **NO. SECTIONS** | 1 | 1 | COMBINED | COMBINED |
| **NO. TUBES/SECTION** | 40 | 26 | 34 | 34 |
| **TUBE LENGTH FEET** | 7.0 | 7.0 | 7.0 | 7.0 |
| **NO. ROWS** | 3 | 4 | 4 | 4 |
| **NO. PASSES** | 4 | 3 | 4 | 6 |
| **COUNTERFLOW** | | | | |
| **TUBE OD INCH AND BWG** | .75X16BWG | .625X16BWG | .625X16BWG | .625X16BWG |
| **TUBE MATERIAL** | SA214(WLD) | SA214(WLD) | SA214(WLD) | SA214(WLD) |
| **DESIGN PRESSURE** | 100.00 | 645.00 | 1287.00 | 1800.00 |
| **DESIGN TEMPERATURE** | 350/-20 | 350/-20 | 350/-20 | 350/-20 |
| **NOZZLES-INLET** | 2-150RF | 2-300RF | 2-600RF | 1.5-900RF |
| **NOZZLES-OUTLET** | 2-150RF | 2-300RF | 2-600RF | 2-900RF |
| **HEADER TYPE** | RECT TUBE | BOX W/PLUGS | BOX W/PLUGS | BOX W/PLUGS |
| **HEADER MATERIAL** | STEEL | SA-516-70 | SA-516-70 NORM | SA-516-70 NORM |
| **ASME CODE STAMP** | | YES | YES | YES |
| **GROOVED TUBE SHEET** | YES | | | YES |
| **HEADER CORROSION INCH** | 0.000 | 0.000 | 0.000 | 0.000 |
| **PLUGS, TYPE** | TAPER | TAPER | TAPER | TAPER |
| **PLUGS, MATERIAL** | STEEL | SA-105 | SA-105 | SA-105 |
| **TURBULATORS** | | | | |
| **ACCELERATORS** | | | | |
| **LOUVER CONTROL** | | MANUAL | MANUAL | (1) JOHNSON 3153-5 W/T12 TC |
| **STRESS RELIEVE** | NONE | NO | NO | NO |
| **NDE** | | | | |
| **ADDITIONAL CODES** | | | | |
| **CANADIAN REGISTRATION** | | | | |
| **ADDITIONAL COUPLINGS** | | 1 | 1 | 2 |
| **BYPASS NOZZLE** | | | | |
| **FINS** | HYPERF L-FOOT | HYPERF L-FOOT | HYPERF L-FOOT | HYPERF L-FOOT |

***AIR DATA***

| | | | |
|---|---|---|---|
| **INLET AIR TEMPERATURE** | 105.0 | **ELEVATION FEET:** | 1500 |
| **OUTLET AIR TEMPERATURE** | 141.1 | **AIR FLOW SCFM:** | 24739 |

***MECHANICAL EQUIPMENT***

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **NO FANS** | 1 | **HP PER FAN:** | 7.0 | **RPM** | 849 | | | **FAN DIA INCH:** | 54 |
| **FAN** | CROWLEY 7WL | **FAN MATERIAL** | PAG | **NUM BLADES** | 6 | **PITCH** | 37° | **TSP, INCH WC:** | 0.721 |
| V-Belt Drive By Others | | | | | | | | | |
| **DRAFT TYPE** | INDUCED | | | | | | | | |
| **WEIGHT LB:** 3852 | | **WIDTH FEET:** 7.7 | | **LENGTH FEET:** 6.8 | | | | **HEIGHT FEET:** 6.5 | |
| **ACCESSORIES** | Personnel Guard Over Air Discharge | | | | | | | | |
| **FINISH** ACE std prep. w/ one coat ACE std primer | | | | | | | | | |
| SPECNOTES | | | | | | | | | |

ACE does not offer metallurgical advisement. Please confirm material suitability for both process and atmospheric conditions.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **HEAT EXCHANGER ACE Model J54 Cooler** | | | |
| | | | | Customer Purchase Order No. | 0019620-03 | Serial No. | ACE1826322 |
| Sales Order No. | 0 | Manufacturer Order No. | ACE1826322 | McClung Energy Services, LLC | | | |

# Section 4: ASME Code Form

# FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS



**(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)**

**As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1**

1. Manufactured and certified by: Alfa Laval, Inc., 1201 South 9th St., Broken Arrow, Oklahoma 74012 (Name and address of Manufacturer)
2. Manufactured for: McClung Energy, 2019 HWY 135 NORTH, KILGORE, TX 75662 (Name and address of Purchaser)
3. Location of installation: Unknown, USA (Name and address)
4. Type: Vertical (Horizontal or vertical, tank) | 1826322-2 (Manufacturer's serial number) | Not Req'd (CRN) | 18263-H2 (Drawing number) | 16746 (National Board number) | 2019 (Year built)
5. ASME Code, Section VIII, Division 1: 2017 [Edition and Addenda, if applicable (date)] | None (Code Case numbers) | None [Special service per UG-120(d)]
6. Shell: SA-516-70 (Material spec. number, grade) | 0.875in (Nominal thickness) | 0 (Corrosion allowance) | 5.625in (Inner diameter) | 11.375in [Length (overall)]

**Body Flanges on Shells**

| No. | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Location | Bolting: Num & Size | Bolting: Bolting Material | Bolting: Washer (OD, ID, thk) | Bolting: Washer Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

7. Seams: Single Bevel [Long. (wld'd, dbl., sngl., lap, butt)] | N.A. [R.T. (spot or full)] | N.A. (Eff., %) | N.A. (H.T. temp.) | N/A (Time, hr) | N.A. [Girth (wld'd, dbl., sngl., lap, butt)] | N.A. [R.T. (spot or full)] | N.A. (Eff., %) | N.A. (No. of courses)
8. Heads: (a) Material: SA-516-70 (Spec. no., grade) (b) Material: SA-516-70 (Spec. no., grade)

| | Location (Top, Bottom, Ends) | Minimum Thickness | Corrosion Allowance | Crown Radius | Knuckle Radius | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side to Pressure (Convex or Concave) |
|---|---|---|---|---|---|---|---|---|---|---|
| (a) | Top/Bottom | 0.5in | 0 | N.A. | N.A. | N.A. | N.A. | N.A. | 4 | N.A. |
| (b) | Ends | 0.5in | 0 | N.A. | N.A. | N.A. | N.A. | N.A. | 4 | N.A. |

**Body Flanges on Heads**

| | Location | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Bolting: Num & Size | Bolting: Bolting Material | Bolting: Washer (OD, ID, thk) | Bolting: Washer Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| (b) | | | | | | | | | | | | |

9. MAWP: 645 psig (Internal) | N.A. (External) at max. temp. 350 deg F (Internal) | N.A. (External)

Min. design metal temp. -20 deg F at 645 psig. Hydrostatic test pressure: 839 psig.

Proof test N/A

10. Nozzles, inspection, and safety valve openings:

| Purpose (Inlet, Outlet, Drain etc.) | No. | Diameter or Size | Type | Material: Nozzle | Material: Flange | Nozzle Thickness: Nom. | Nozzle Thickness: Corr. | Reinforcement Material | Attachment Details: Nozzle | Attachment Details: Flange | Location (Insp. Open.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet/Outlet Nozzle | 2 | 2 In. | Pipe | SA-106-GR B | N.A. | 0.218 | 0 | Mat'l&Weld | UW16.1(a) | N.A. | Header |
| Inlet/Outlet Flange | 2 | 2 In. | RFWN | N.A. | SA-105 | 300RF | N.A. | Mat'l&Weld | N.A. | Welded | Header |
| Auxiliary | 1 | 1 In. | Cpling | SA-105 | N.A. | 3000# | 0 | Mat'l&Weld | Welded | N.A. | Header |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

11. Supports: Skirt: No (Yes or no) Lugs: 0 (Number) Legs: 4 (Number) Other: N/A (Describe) Attached: Tubesheet/Welded (Where and how)
12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: See Next Line (Name of part, item number, Manufacturer's name and identifying stamp)

IMPACT EXEMPT PER UG-20(f). Section Volume = 0.6 cubic feet.

Tubes: (26) SA214(WLD) x 0.625 in. OD x 0.06 in. MW x 7 ft. Long, Straight Type

Plugs: (52) SA-105 Taper Plugs

NDE: N/A

## FORM U-1A (Back)

Manufactured by Alfa Laval, Inc., 1201 South 9th St., Broken Arrow, Oklahoma 74012

Manufacturer's Serial No. 1826322-2 CRN Not Req'd National Board No. 16746

### CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that il details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 7616 expires 4/30/2020.

Date 1/21/2019 Co. name Alfa Laval, Inc. (Manufacturer) Signed Darrell Rigg (Representative)

### CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Alfa Laval, Inc. at 1201 S. 9th St. Broken Arrow, OK 74012.

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by OneCIS Insurance Co., Lynn, Mass.

have inspeced the component described in this Manufacturer's Data Report on 1-21-19, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the inspector nor his/her empolyer makes and warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 1-21-19 Signed (Authorized Inspector) Commissions NB 8432 [National Board (Incl. endorsements)]

(07/17)

Service: IC1

# FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS

**(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)**

**As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1**

1. Manufactured and certified by: Alfa Laval, Inc., 1201 South 9th St., Broken Arrow, Oklahoma 74012 (Name and address of Manufacturer)
2. Manufactured for: McClung Energy, 2019 HWY 135 NORTH, KILGORE, TX 75662 (Name and address of Purchaser)
3. Location of installation: Unknown, USA (Name and address)

| 4. Type | (Manufacturer's serial number) | (CRN) | (Drawing number) | (National Board number) | (Year built) |
|---|---|---|---|---|---|
| Vertical (Horizontal or vertical, tank) | 1826322-3A | Not Req'd | 18263-H3 rev 2 | 16747 | 2019 |

| 5. ASME Code, Section VIII, Division 1 | [Edition and Addenda, if applicable (date)] | (Code Case numbers) | [Special service per UG-120(d)] |
|---|---|---|---|
| | 2017 | None | None |

| 6. Shell | (Material spec. number, grade) | (Nominal thickness) | (Corrosion allowance) | (Inner diameter) | [Length (overall)] |
|---|---|---|---|---|---|
| | SA-516-70 NORM | 1.625in | 0 | 5.5in | 13.9379997253417in |

**Body Flanges on Shells**

| No. | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Location | Bolting: Num & Size | Bolting: Bolting Material | Bolting: Washer (OD, ID, thk) | Bolting: Washer Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

7. Seams

| [Long. (wld'd, dbl., sngl., lap, butt)] | [R.T. (spot or full)] | (Eff., %) | (H.T. temp.) | (Time, hr) | [Girth (wld'd, dbl., sngl., lap, butt)] | [R.T. (spot or full)] | (Eff., %) | (No. of courses) |
|---|---|---|---|---|---|---|---|---|
| Single Bevel | N.A. | N.A. | N.A. | N/A | N.A. | N.A. | N.A. | N.A. |

8. Heads: (a) Material: SA-516-70 NORM (Spec. no., grade) (b) Material: SA-516-70 NORM (Spec. no., grade)

| | Location (Top, Bottom, Ends) | Minimum Thickness | Corrosion Allowance | Crown Radius | Knuckle Radius | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side to Pressure (Convex or Concave) |
|---|---|---|---|---|---|---|---|---|---|---|
| (a) | Top/Bottom | 0.75in | 0 | N.A. | N.A. | N.A. | N.A. | N.A. | 2in | N.A. |
| (b) | Ends | 0.75in | 0 | N.A. | N.A. | N.A. | N.A. | N.A. | 2in | N.A. |

**Body Flanges on Heads**

| | Location | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Bolting: Num & Size | Bolting: Bolting Material | Bolting: Washer (OD, ID, thk) | Bolting: Washer Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| (b) | | | | | | | | | | | | |

9. MAWP: 1287 psig (Internal) / N.A. (External) at max. temp.: 350 deg F (Internal) / N.A. (External).
Min. design metal temp.: -20 deg F at 1287 psig. Hydrostatic test pressure: 1673 psig.
Proof test: N/A

10. Nozzles, inspection, and safety valve openings:

| Purpose (Inlet, Outlet, Drain etc.) | No. | Diameter or Size | Type | Material: Nozzle | Material: Flange | Nozzle Thickness: Nom. | Nozzle Thickness: Corr. | Reinforcement Material | Attachment Details: Nozzle | Attachment Details: Flange | Location (Insp. Open.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet/Outlet Nozzle | 2 | 2 In. | Pipe | SA-106-GR B | N.A. | 0.218 | 0 | Mat'l&Weld | UW16.1(a) | N.A. | Header |
| Inlet/Outlet Flange | 2 | 2 In. | RFWN | N.A. | SA-105 | 600RF | N.A. | Mat'l&Weld | N.A. | Welded | Header |
| Auxiliary | 1 | 1 In. | Cpling | SA-105 | N.A. | 3000# | 0 | Mat'l&Weld | Welded | N.A. | Header |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

11. Supports: Skirt: No (Yes or no) Lugs: 0 (Number) Legs: 4 (Number) Other: N/A (Describe) Attached: Tubesheet/Welded (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: See Next Line (Name of part, Item number, Manufacturer's name and identifying stamp)

IMPACT EXEMPT PER UCS-66 (curve d). Section Volume = 0.6 cubic feet.

Tubes: (34) SA214(WLD) x 0.625 in. OD x 0.06 in. MW x 7 ft. Long, Straight Type

Plugs: (68) SA-105 Taper Plugs

NDE: N/A

## FORM U-1A (Back)

Manufactured by Alfa Laval, Inc., 1201 South 9th St., Broken Arrow, Oklahoma 74012

Manufacturer's Serial No. 1826322-3A CRN Not Req'd National Board No. 16747

### CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that ll details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 7616 expires 4/30/2020.

Date 1/21/2019 Co. name Alfa Laval, Inc. (Manufacturer) Signed [signature] (Representative)

### CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Alfa Laval, Inc. at 1201 S. 9th St. Broken Arrow, OK 74012.

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by OneCIS Insurance Co., Lynn, Mass.

have inspeced the component described in this Manufacturer's Data Report on 1-21-19, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the inspector nor his/her empolyer makes and warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 1-21-19 Signed [signature] (Authorized Inspector) Commissions 18, 8439 [National Board (Incl. endorsements)]

(07/17)

Service: IC2

# FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS

**(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)**

**As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1**

1. Manufactured and certified by: Alfa Laval, Inc., 1201 South 9th St., Broken Arrow, Oklahoma 74012 (Name and address of Manufacturer)
2. Manufactured for: McClung Energy, 2019 HWY 135 NORTH, KILGORE, TX 75662 (Name and address of Purchaser)
3. Location of installation: Unknown, USA (Name and address)
4. Type: Vertical (Horizontal or vertical, tank) | 1826322-3B (Manufacturer's serial number) | Not Req'd (CRN) | 18263-H3 rev 2 (Drawing number) | 16748 (National Board number) | 2019 (Year built)
5. ASME Code, Section VIII, Division 1: 2017 [Edition and Addenda, if applicable (dete)] | None (Code Case numbers) | None [Special service per UG-120(d)]
6. Shell: SA-516-70 NORM (Material spec. number, grade) | 1.625in (Nominal thickness) | 0 (Corrosion allowance) | 5.5in (Inner diameter) | 13.9379997253417in [Length (overall)]

**Body Flanges on Shells**

| No. | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Location | Bolting: Num & Size | Bolting: Bolting Material | Bolting: Washer (OD, ID, thk) | Bolting: Washer Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

7. Seams: Single Bevel [Long. (wld'd, dbl., sngl., lap, butt)] | N.A. [R.T. (spot or full)] | N.A. (Eff., %) | N.A. (H.T. temp.) | N/A (Time, hr) | N.A. [Girth (wld'd, dbl., sngl., lap, butt)] | N.A. [R.T. (spot or full)] | N.A. (Eff., %) | N.A. (No. of courses)
8. Heads: (a) Material: SA-516-70 NORM (Spec. no., grade) (b) Material: SA-516-70 NORM (Spec. no., grade)

| | Location (Top, Bottom, Ends) | Minimum Thickness | Corrosion Allowance | Crown Radius | Knuckle Radius | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side to Pressure (Convex or Concave) |
|---|---|---|---|---|---|---|---|---|---|---|
| (a) | Top/Bottom | 0.75in | 0 | N.A. | N.A. | N.A. | N.A. | N.A. | 2in | N.A. |
| (b) | Ends | 0.75in | 0 | N.A. | N.A. | N.A. | N.A. | N.A. | 2in | N.A. |

**Body Flanges on Heads**

| | Location | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Bolting: Num & Size | Bolting: Bolting Material | Bolting: Washer (OD, ID, thk) | Bolting: Washer Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| (b) | | | | | | | | | | | | |

9. MAWP: 1800 psig (Internal) / N.A. (External) at max. temp. 350 deg F (Internal) / N.A. (External).
   Min. design metal temp. -20 deg F at 1800 psig. Hydrostatic test pressure: 2340 psig.
   Proof test N/A.
10. Nozzles, inspection, and safety valve openings:

| Purpose (Inlet, Outlet, Drain etc.) | No. | Diameter or Size | Type | Material: Nozzle | Material: Flange | Nozzle Thickness: Nom. | Nozzle Thickness: Corr. | Reinforcement Material | Attachment Details: Nozzle | Attachment Details: Flange | Location (Insp. Open.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet Nozzle | 1 | 1.5 In. | Pipe | SA-106-GR B | N.A. | 0.2 | 0 | Mat'l&Weld | UW16.1(a) | N.A. | Header |
| Inlet Flange | 1 | 1.5 In. | RFWN | N.A. | SA-105 | 900RF | N.A. | Mat'l&Weld | N.A. | Welded | Header |
| Outlet Nozzle | 1 | 2 In. | Pipe | SA-106-GR B | N.A. | 0.218 | 0 | Mat'l&Weld | UW16.1(a) | N.A. | Header |
| Outlet Flange | 1 | 2 In. | RFWN | N.A. | SA-105 | 900RF | N.A. | Mat'l&Weld | N.A. | Welded | Header |
| Auxiliary | 2 | 1 In. | Cpling | SA-105 | N.A. | 3000# | 0 | Mat'l&Weld | Welded | N.A. | Header |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

11. Supports: Skirt: No (Yes or no) Lugs: 0 (Number) Legs: 4 (Number) Other: N/A (Describe) Attached: Tubesheet/Welded (Where and how)
12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: See Next Line (Name of part, item number, Manufacturer's name and identifying stamp)

IMPACT EXEMPT PER UCS-66 (curve d). Section Volume = 0.5 cubic feet.

Tubes: (34) SA214(WLD) x 0.625 in. OD x 0.06 in. MW x 7 ft. Long, Straight Type

Plugs: (68) SA-105 Taper Plugs

NDE: N/A

## FORM U-1A (Back)

Manufactured by Alfa Laval, Inc., 1201 South 9th St., Broken Arrow, Oklahoma 74012

Manufacturer's Serial No. 1826322-3B CRN Not Req'd National Board No. 16748

### CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that ll details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 7616 expires 4/30/2020.

Date 1/21/2019 Co. name Alfa Laval, Inc. (Manufacturer) Signed [signature] (Representative)

### CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Alfa Laval, Inc. at 1201 S. 9th St. Broken Arrow, OK 74012.

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by OneCIS Insurance Co., Lynn, Mass.

have inspeced the component described in this Manufacturer's Data Report on 1-21-19, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the inspector nor his/her empolyer makes and warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

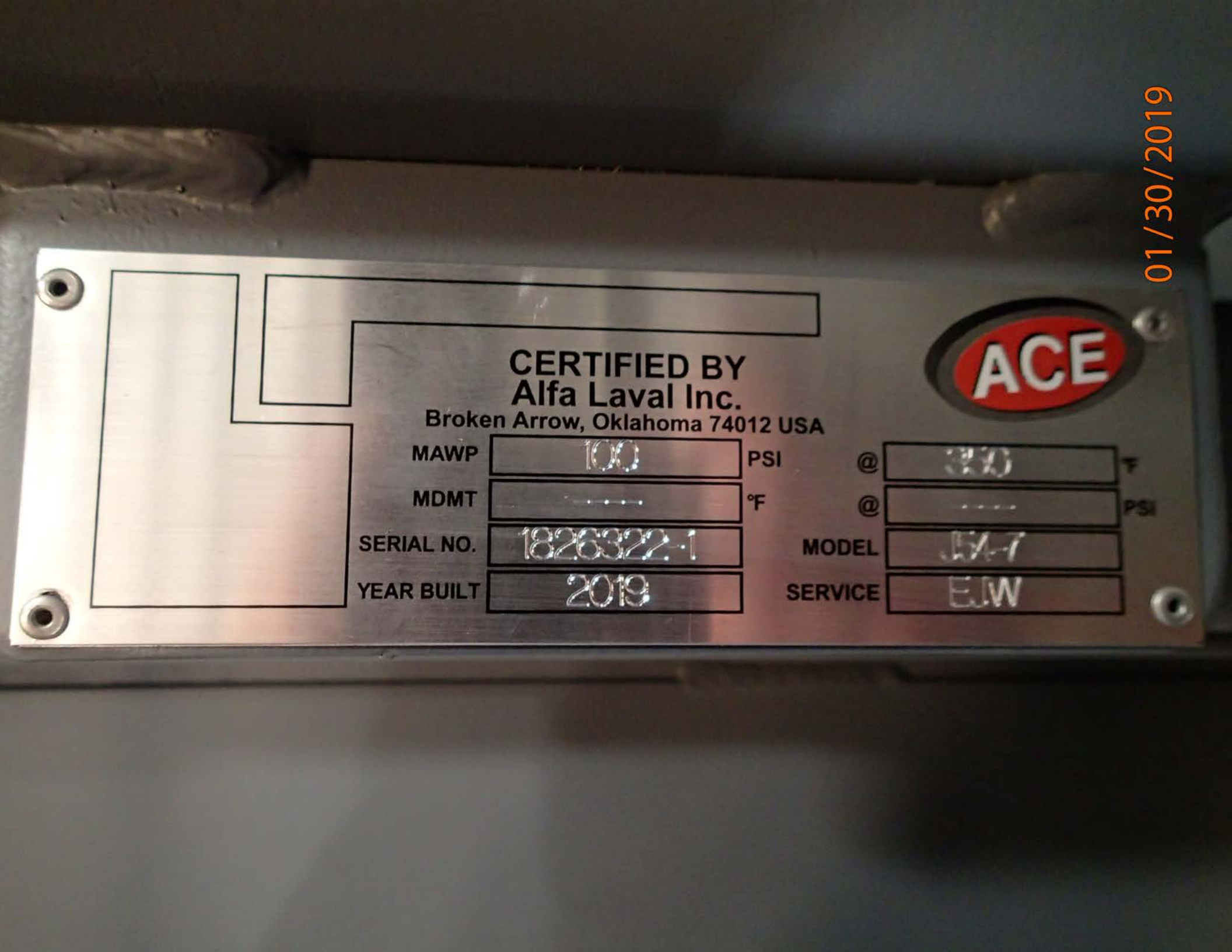
Date 1-21-19 Signed [signature] (Authorized Inspector) Commissions NB. 8432 [National Board (Incl. endorsements)]

(07/17)

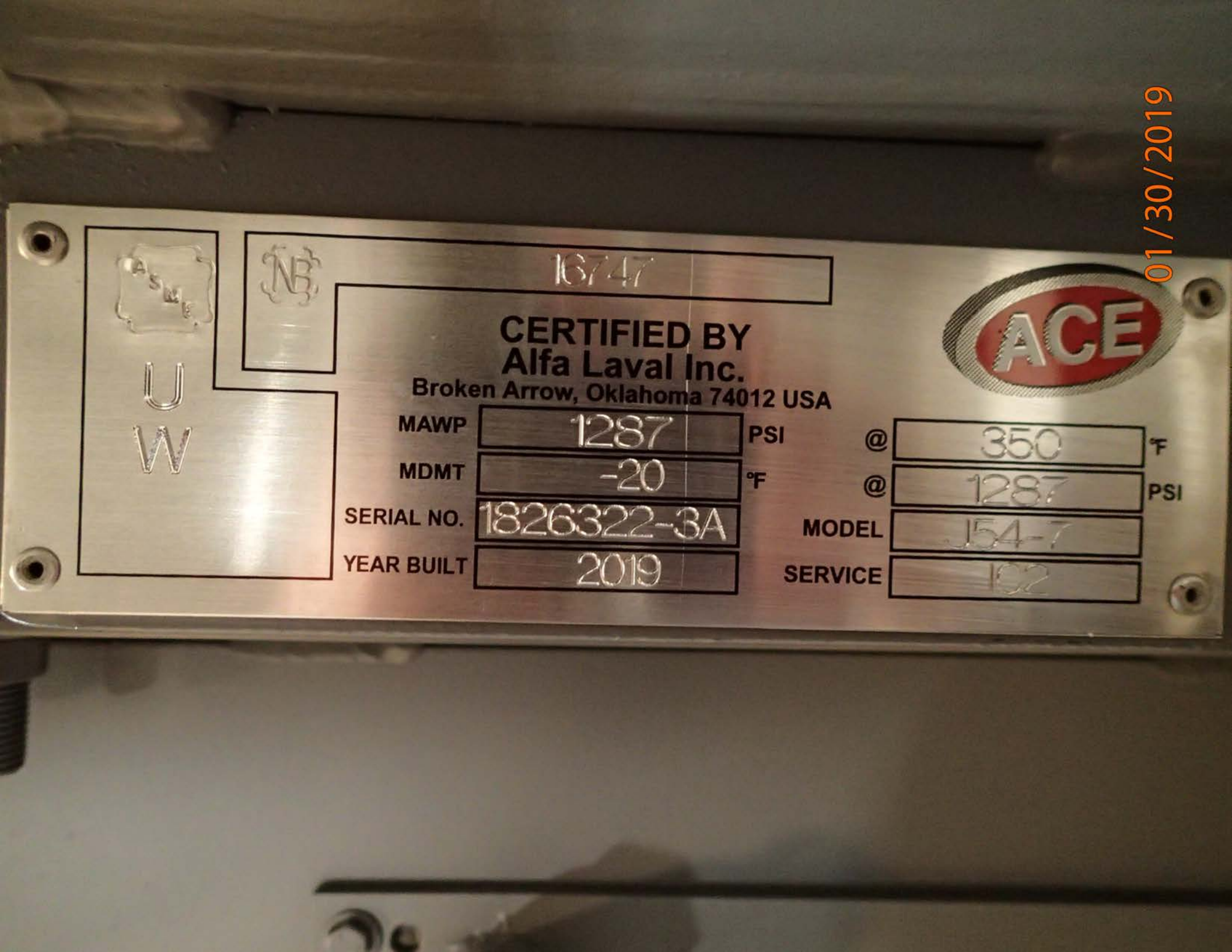
Service: AC

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **HEAT EXCHANGER ACE Model J54 Cooler** | | | |
| | | | | Customer Purchase Order No. | 0019620-03 | Serial No. | ACE1826322 |
| Sales Order No. | 0 | Manufacturer Order No. | ACE1826322 | McClung Energy Services, LLC | | | |

# Section 5: ASME Unit Tags


01/30/2019
CERTIFIED BY
Alfa Laval Inc.
Broken Arrow, Oklahoma 74012 USA
ACE
MAWP
100
PSI
@
MDMT
°F
@
PSI
SERIAL NO.
1826322-1
MODEL
YEAR BUILT
2019
SERVICE
E.W


01/30/2019
16746
CERTIFIED BY
Alfa Laval Inc.
Broken Arrow, Oklahoma 74012 USA
ACE
U
W
MAWP
645
PSI
@
350
°F
MDMT
-20
°F
@
615
PSI
SERIAL NO.
1826322-2
MODEL
J54-7
YEAR BUILT
2019
SERVICE
IC1


01/30/2019
ASME
NB
16747
U
W
CERTIFIED BY
Alfa Laval Inc.
Broken Arrow, Oklahoma 74012 USA
ACE
MAWP 1287 PSI @ 350 °F
MDMT -20 °F @ 1287 PSI
SERIAL NO. 1826322-3A
MODEL J54-7
YEAR BUILT 2019
SERVICE 102


01/30/2019
16748
CERTIFIED BY
Alfa Laval Inc.
Broken Arrow, Oklahoma 74012 USA
ACE
U
W
MAWP 1800 PSI @ 350 °F
MDMT -20 °F @ 1800 PSI
SERIAL NO. 1826322-3B
MODEL J54-7
YEAR BUILT 2019
SERVICE AC

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **HEAT EXCHANGER ACE Model J54 Cooler** | | | |
| | | | | Customer Purchase Order No. | 0019620-03 | Serial No. | ACE1826322 |
| Sales Order No. | 0 | Manufacturer Order No. | ACE1826322 | McClung Energy Services, LLC | | | |

# Section 6: ASME Code Calculations

# ASME Code Calculations

Section VIII, Div. 1, Appendix 13, Fig 13-2(a), Sketch (1), 2017 Edition

Customer: McClung Energy
Purchase Order Number: 0019620-03
Date: 01/11/2019
ACE Job Number: 1826316-27
Section Name/Serial Number: IC1
Tag:

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Header Material: SA-516-70
Code Allowable Stress, **S**: 20000 PSI (137.895 MPa)
Tube Diameter: 0.625 inch (15.88 mm)
Tube Pitch: 1.500 inch (38.100 mm)
**C.A.,** Corrosion Allowance: 0.000 inch (0.0 mm)
**P,** Design Pressure: 645 PSI (4.4 MPa)
Maximum Design Temperature: 350 deg F (177 deg C)
Minimum Design Temperature: -20 deg F (-29 deg C)
Stress Relief: No
Plug Type: TAPER
Overall Header Width: 5.7500 Inch (146.05 mm)
Overall Header Height: 6.625 inch (168.28 mm)
$t_1$, Short Side Plate Thickness, Corroded: 0.500 inch (12.70 mm)
$t_2$, Long Side Plate Thickness, Corroded: 0.875 inch (22.23 mm)
$D_p$, Plug Thread Diameter: 0.768 inch (19.52 mm)
Hydrostatic Test Pressure: 839 PSI (5.8 MPa)
**h,** Long Inside Dimension, Corroded: 5.6250 inch (142.88 mm)
**H,** Short Inside Dimension, Corroded: 4.0000 inch (101.60 mm)

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***Calculated Variables***

$e_m = e_b = \frac{Tube\ Pitch - Dp}{Tube\ Pitch} = \frac{(1.500-0.7684)}{1.500} = 0.48773$ $\alpha = H/h = 4.0000/5.6250 = 0.71111$

$I_1 = \frac{(t_1)^3}{12} = \frac{(0.500)^3}{12} = 0.0104167$ $I_2 = \frac{(t_2)^3}{12} = \frac{(0.875)^3}{12} = 0.0558268$ $K = \alpha \frac{(I_2)}{(I_1)} = 0.71111 \frac{(0.0558268)}{(0.0104167)} = 3.81111$

$1 + \alpha^2 K = 1 + 0.71111^2 3.81111 = 2.92720$ $1 + K = 1 + 3.81111 = 4.81111$

$c_1 = 0.5 \times t_1 = 0.5 \times 0.500 = 0.25000$ $c_2 = 0.5 \times t_2 = 0.5 \times 0.875 = 0.43750$

***Membrane Stress (Not to Exceed 20000 PSI)***

Short Side Plates: $S_m = \frac{Ph}{2t_1 * em} = \frac{645*5.6250}{2*0.500*1.00000} = 3628.1\ PSI, 25.015\ MPa$ ❶

Long Side Plates: $S_m = \frac{PH}{2t_2 * em} = \frac{645*4.0000}{2*0.875*0.48773} = 3022.7\ PSI, 20.841\ MPa$ ❷

---

***Bending Stress***

Short Side Plates:

$(S_b)_N = \pm \frac{P*c_1}{12I_1*e_b}\left[1.5H^2 - h^2\frac{1+\alpha^2K}{1+K}\right] = \pm \frac{645*0.25000}{12*0.0104167*1.00000}\left[1.5*4.0000^2 - 5.6250^2 * \frac{1+0.71111^2*3.81111}{1+3.81111}\right] = 6126.3\ PSI, 42.239\ MPa$ ❸

$(S_b)_Q = \pm \frac{P*h^2*c_1}{12*I_1}\left[\frac{1+\alpha^2*K}{1+K}\right] = \pm \frac{645*5.6250^2*0.25000}{12*0.0104167}\left[\frac{1+0.71111^2*3.81111}{1+3.81111}\right] = \pm\ 24833.7\ PSI, 171.222\ MPa$ ❹

Long Side Plates:

$(S_t)_M = \pm \frac{P*h^2*c_2}{12I_2*e_b}\left[1.5 - \frac{1+\alpha^2K}{1+K}\right] = \pm \frac{645*5.6250^2*0.43750}{12*0.0558268*0.48773}\left[1.5 - \frac{1+0.71111^2*3.81111}{1+3.81111}\right] = \pm\ 24363.2\ PSI, 167.978\ MPa$ ❺

$(S_t)_Q = \pm \frac{P*h^2*c_2}{12I_2}\left[\frac{1+\alpha^2K}{1+K}\right] = \pm \frac{645*5.6250^2*0.43750}{12*0.0558268}\left[\frac{1+0.71111^2*3.81111}{1+3.81111}\right] = \pm\ 8109.0\ PSI, 55.909\ MPa$ ❻

---

***Combined Stress (Not to Exceed 30000 PSI)***

Short Side Plates:

$(S_T)_N$ = ❶ + ❸ = 3628.1 PSI, 25.015 MPa + 6126.3 PSI, 42.239 MPa = 9754.4 PSI, 67.254 MPa ❼

$(S_T)_Q$ = ❶ + ❹ = 3628.1 PSI, 25.015 MPa + 24833.7 PSI, 171.222 MPa = 28461.8 PSI, 196.237 MPa ❽

Long Side Plates:

$(S_T)_M$ = ❷ + ❺ = 3022.7 PSI, 20.841 MPa + 24363.2 PSI, 167.978 MPa = 27385.9 PSI, 188.819 MPa ❾

$(S_T)_Q$ = ❷ + ❻ = 3022.7 PSI, 20.841 MPa + 8109.0 PSI, 55.909 MPa = 11132 PSI, 76.750 MPa ❿

***End Plate Thickness (Per UG-34)***

Where $T_M$ = Minimum Thickness

$$T_M = C.A. + H * \sqrt{\left[\left(3.4 - 2.4 * \frac{H}{h}\right) * \left(\frac{0.2 * P}{S}\right)\right]}$$

$T_M =$ Error! Reference source not found. +Error! Reference source not found.$* \sqrt{\left[\left(3.4 - 2.4 * \frac{4.0000}{5.6250}\right) * \left(\frac{0.2 * 645}{20000}\right)\right]}$

= 0.418 In, 10.618 mm

End Plate Thickness Selected by Program: 0.500 In, 12.700 mm

***Pipe and Tube Stresses***

Where $T_E$ = Effective Thickness
$T_A$ = Actual Thickness
$D_0$ = Pipe or Tube Outer Diameter
$R_0$ = Pipe or Tube Outer Radius
$T_M$ = Minimum Thickness
S = Stress

Nozzle 1 (2.375 inch O.D. X 0.218 in Thick Inlet Pipe, SA-106-GR B):
Allowable Stress: Not to Exceed 17100.0 PSI, 117.905 MPa

$T_E = (T_A \times 0.875) - C.A. = (0.2180 \times 0.875) - 0.000 = 0.1907$ in, 4.8450 mm

$R_0 = D_0/2 = 2.3750/2 = 1.1875$

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = 645\left(\frac{1.1875}{0.1907} - 0.4\right) = 3757.400\ PSI\ \ 25.907\ MPa$$

Nozzle 2 (2.375 inch O.D. X 0.218 in Thick Outlet Pipe, SA-106-GR B):
Allowable Stress: Not to Exceed 17100.0 PSI, 117.905 MPa

$T_E = (T_A \times 0.875) - C.A. = (0.2180 \times 0.875) - 0.000 = 0.1907$ in, 4.8450 mm

$R_0 = D_0/2 = 2.3750/2 = 1.1875$

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = 645\left(\frac{1.1875}{0.1907} - 0.4\right) = 3757.400\ PSI\ \ 25.907\ MPa$$

Nozzle 3 (Not applicable, Nozzle 3 does not exist for this section):
Allowable Stress: Not applicable

$T_E = (T_A \times 0.875) - C.A. = (\text{Not applicable} \times 0.875) - 0.000 = \text{Not applicable}$

$R_0 = D_0/2 = \text{Not applicable}/2 = \text{Not applicable}$

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = Not\ applicable\left(\frac{Not\ applicable}{Not\ applicable} - 0.4\right) =$$

Tubes (SA214(WLD)):
Tube Allowable Stress: 11400 PSI, 78.6 Mpa

$T_M = \frac{P*0.5*D_O}{S+0.4*P} = \frac{645*0.5*0.625}{11400+0.4*645}$ = 0.017 In, 0.439 mm

Tube Wall Thickness Selected by Program: 0.060 In, 1.524 mm

---

Calculations Generated By: Name

# ASME Code Calculations

Section VIII, Div. 1, Appendix 13, Fig 13-2(a), Sketch (1), 2017 Edition

Customer: McClung Energy
Purchase Order Number: 0019620-03
Date: 1/11/2019
ACE Job Number: 1826316-27
Section Name/Serial Number: IC2
Tag:

---

Header Material: SA-516-70 NORM
Code Allowable Stress, **S**: 20000 PSI (137.895 MPa)
Tube Diameter: 0.625 inch (15.88 mm)
Tube Pitch: 1.500 inch (38.100 mm)
**C.A.,** Corrosion Allowance: 0.000 inch (0.0 mm)
**P,** Design Pressure: 1287 PSI (8.9 MPa)
Maximum Design Temperature: 350 deg F (177 deg C)
Minimum Design Temperature: -20 deg F (-29 deg C)
Stress Relief: No
Plug Type: TAPER
Overall Header Width: 5.2500 Inch (133.35 mm)
Overall Header Height: 6.750 inch (171.45 mm)
$t_1$, Short Side Plate Thickness, Corroded: 0.625 inch (15.88 mm)
$t_2$, Long Side Plate Thickness, Corroded: 1.625 inch (41.28 mm)
$D_p$, Plug Thread Diameter: 0.768 inch (19.52 mm)
Hydrostatic Test Pressure: 1673 PSI (11.5 MPa)
**h,** Long Inside Dimension, Corroded: 5.5000 inch (139.70 mm)
**H,** Short Inside Dimension, Corroded: 2.0000 inch (50.80 mm)

---

***Calculated Variables***

$e_m = e_b = \frac{Tube\ Pitch - Dp}{Tube\ Pitch} = \frac{(1.500-0.7684)}{1.500} = 0.48773$ $\alpha = H/h = 2.0000/5.5000 = 0.36364$

$I_1 = \frac{(t_1)^3}{12} = \frac{(0.625)^3}{12} = 0.0203451$ $I_2 = \frac{(t_2)^3}{12} = \frac{(1.625)^3}{12} = 0.3575846$ $K = \alpha \frac{(I_2)}{(I_1)} = 0.36364 \frac{(0.3575846)}{(0.0203451)} = 6.39127$

$1 + \alpha^2 K = 1 + 0.36364^2 6.39127 = 1.84513$ $1 + K = 1 + 6.39127 = 7.39127$

$c_1 = 0.5 \times t_1 = 0.5 \times 0.625 = 0.31250$ $c_2 = 0.5 \times t_2 = 0.5 \times 1.625 = 0.81250$

***Membrane Stress (Not to Exceed 20000 PSI)***

Short Side Plates: $S_m = \frac{Ph}{2t_1 * em} = \frac{1287*5.5000}{2*0.625*1.00000} = 7920.0\ PSI, 54.606\ MPa$ ❶

Long Side Plates: $S_m = \frac{PH}{2t_2 * em} = \frac{1287*2.0000}{2*1.625*0.48773} = 2271.1\ PSI, 15.659\ MPa$ ❷

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***Bending Stress***

Short Side Plates:

$(S_b)_N = \pm \frac{P*c_1}{12I_1*e_b}\left[1.5H^2 - h^2\frac{1+\alpha^2K}{1+K}\right] = \pm \frac{1287*0.31250}{12*0.0203451*1.00000}\left[1.5*2.0000^2 - 5.5000^2 * \frac{1+0.36364^2*6.39127}{1+6.39127}\right] =$
$3574.6\ PSI, 24.646\ MPa$ ❸

$(S_b)_Q = \pm \frac{P*h^2*c_1}{12*I_1}\left[\frac{1+\alpha^2*K}{1+K}\right] = \pm \frac{1287*5.5000^2*0.31250}{12*0.0203451}\left[\frac{1+0.36364^2*6.39127}{1+6.39127}\right] = \pm\ 17398.6\ PSI, 119.959\ MPa$ ❹

Long Side Plates:

$(S_t)_M = \pm \frac{P*h^2*c_2}{12I_2*e_b}\left[1.5 - \frac{1+\alpha^2K}{1+K}\right] = \pm \frac{1287*5.5000^2*0.81250}{12*0.3575846*0.48773}\left[1.5 - \frac{1+0.36364^2*6.39127}{1+6.39127}\right] = \pm\ 26431.1\ PSI, 182.236\ MPa$
❺

$(S_t)_Q = \pm \frac{P*h^2*c_2}{12I_2}\left[\frac{1+\alpha^2K}{1+K}\right] = \pm \frac{1287*5.5000^2*0.81250}{12*0.3575846}\left[\frac{1+0.36364^2*6.39127}{1+6.39127}\right] = \pm\ 2573.8\ PSI, 17.745\ MPa$ ❻

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***Combined Stress (Not to Exceed 30000 PSI)***

Short Side Plates:

$(S_T)_N$ = ❶ + ❸ = 7920.0 PSI, 54.606 MPa + 3574.6 PSI, 24.646 MPa = 11494.6 PSI, 79.253 MPa ❼

$(S_T)_Q$ = ❶ + ❹ = 7920.0 PSI, 54.606 MPa + 17398.6 PSI, 119.959 MPa = 25318.6 PSI, 174.566 MPa ❽

Long Side Plates:

$(S_T)_M$ = ❷ + ❺ = 2271.1 PSI, 15.659 MPa + 26431.1 PSI, 182.236 MPa = 28702.2 PSI, 197.895 MPa ❾

$(S_T)_Q$ = ❷ + ❻ = 2271.1 PSI, 15.659 MPa + 2573.8 PSI, 17.745 MPa = 4845 PSI, 33.404 MPa ❿

***End Plate Thickness (Per UG-34)***

Where $T_M$ = Minimum Thickness

$$T_M = C.A. + H * \sqrt{\left[\left(3.4 - 2.4 * \frac{H}{h}\right) * \left(\frac{0.2 * P}{S}\right)\right]}$$

$T_M =$ Error! Reference source not found. +Error! Reference source not found.$* \sqrt{\left[\left(3.4 - 2.4 * \frac{2.0000}{5.5000}\right) * \left(\frac{0.2 * 1287}{20000}\right)\right]}$

= 0.427 In, 10.835 mm

End Plate Thickness Selected by Program: 0.625 In, 15.875 mm

***Pipe and Tube Stresses***

Where $T_E$ = Effective Thickness
$T_A$ = Actual Thickness
$D_0$ = Pipe or Tube Outer Diameter
$R_0$ = Pipe or Tube Outer Radius
$T_M$ = Minimum Thickness
S = Stress

Nozzle 1 (2.375 inch O.D. X 0.218 in Thick Inlet Pipe, SA-106-GR B):
Allowable Stress: Not to Exceed 17100.0 PSI, 117.905 MPa

$T_E = (T_A \times 0.875) - C.A. = (0.2180 \times 0.875) - 0.000 = 0.1907$ in, 4.8450 mm

$R_0 = D_0/2 = 2.3750/2 = 1.1875$

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = 1287\left(\frac{1.1875}{0.1907} - 0.4\right) = 7497.323\ PSI\ \ 51.694\ MPa$$

Nozzle 2 (2.375 inch O.D. X 0.218 in Thick Outlet Pipe, SA-106-GR B):
Allowable Stress: Not to Exceed 17100.0 PSI, 117.905 MPa

$T_E = (T_A \times 0.875) - C.A. = (0.2180 \times 0.875) - 0.000 = 0.1907$ in, 4.8450 mm

$R_0 = D_0/2 = 2.3750/2 = 1.1875$

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = 1287\left(\frac{1.1875}{0.1907} - 0.4\right) = 7497.323\ PSI\ \ 51.694\ MPa$$

Nozzle 3 (Not applicable, Nozzle 3 does not exist for this section):
Allowable Stress: Not applicable

$T_E$ = ($T_A$ x 0.875) – C.A. = (Not applicable x 0.875) – 0.000 = Not applicable

$R_0$ = $D_0$/2 = Not applicable/2 = Not applicable

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = Not\ applicable\left(\frac{Not\ applicable}{Not\ applicable} - 0.4\right) =$$

Tubes (SA214(WLD)):
Tube Allowable Stress: 11400 PSI, 78.6 Mpa

$T_M = \frac{P*0.5*D_O}{S+0.4*P} = \frac{1287*0.5*0.625}{11400+0.4*1287}$ = 0.034 In, 0.857 mm

Tube Wall Thickness Selected by Program: 0.060 In, 1.524 mm

---

Calculations Generated By: Name

# ASME Code Calculations

Section VIII, Div. 1, Appendix 13, Fig 13-2(a), Sketch (1), 2017 Edition

Customer: McClung Energy
Purchase Order Number: 0019620-03
Date: 01/11/2019
ACE Job Number: 1826316-27
Section Name/Serial Number: AC
Tag:

---

Header Material: SA-516-70 NORM
Code Allowable Stress, **S**: 20000 PSI (137.895 MPa)
Tube Diameter: 0.625 inch (15.88 mm)
Tube Pitch: 1.500 inch (38.100 mm)
**C.A.,** Corrosion Allowance: 0.000 inch (0.0 mm)
**P,** Design Pressure: 1800 PSI (12.4 MPa)
Maximum Design Temperature: 350 deg F (177 deg C)
Minimum Design Temperature: -20 deg F (-29 deg C)
Stress Relief: No
Plug Type: TAPER
Overall Header Width: 5.2500 Inch (133.35 mm)
Overall Header Height: 6.750 inch (171.45 mm)
$\mathbf{t_1}$, Short Side Plate Thickness, Corroded: 0.625 inch (15.88 mm)
$\mathbf{t_2}$, Long Side Plate Thickness, Corroded: 1.625 inch (41.28 mm)
$\mathbf{D_p}$, Plug Thread Diameter: 0.768 inch (19.52 mm)
Hydrostatic Test Pressure: 2340 PSI (16.1 MPa)
**h,** Long Inside Dimension, Corroded: 5.2500 inch (133.35 mm)
**H,** Short Inside Dimension, Corroded: 2.0000 inch (50.80 mm)

---

***Calculated Variables***

$e_m = e_b = \frac{Tube\ Pitch - Dp}{Tube\ Pitch} = \frac{(1.500-0.7684)}{1.500} = 0.48773$ $\alpha = H/h = 2.0000/5.2500 = 0.76190$

$I_1 = \frac{(t_1)^3}{12} = \frac{(0.625)^3}{12} = 0.0558268$ $I_2 = \frac{(t_2)^3}{12} = \frac{(1.625)^3}{12} = 0.2166341$ $K = \alpha \frac{(I_2)}{(I_1)} = 0.76190 \frac{(0.2166341)}{(0.0558268)} = 2.95655$

$1 + \alpha^2 K = 1 + 0.76190^2 2.95655 = 2.71627$ $1 + K = 1 + 2.95655 = 3.95655$

$c_1 = 0.5 \times t_1 = 0.5 \times 0.625 = 0.43750$ $c_2 = 0.5 \times t_2 = 0.5 \times 1.625 = 0.68750$

***Membrane Stress (Not to Exceed 20000 PSI)***

Short Side Plates: $S_m = \frac{Ph}{2t_1 * em} = \frac{1800*5.2500}{2*0.625*1.00000} = 5400.0\ PSI, 37.232\ MPa$ ❶

Long Side Plates: $S_m = \frac{PH}{2t_2 * em} = \frac{1800*2.0000}{2*1.625*0.48773} = 5368.1\ PSI, 37.011\ MPa$ ❷

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***Bending Stress***

Short Side Plates:

$(S_b)_N = \pm \frac{P*c_1}{12I_1*e_b}\left[1.5H^2 - h^2\frac{1+\alpha^2K}{1+K}\right] = \pm \frac{1800*0.43750}{12*0.0558268*1.00000}\left[1.5*2.0000^2 - 5.2500^2 * \frac{1+0.76190^2*2.95655}{1+2.95655}\right] = 5968.8\ PSI, 41.153\ MPa$ ❸

$(S_b)_Q = \pm \frac{P*h^2*c_1}{12*I_1}\left[\frac{1+\alpha^2*K}{1+K}\right] = \pm \frac{1800*5.2500^2*0.43750}{12*0.0558268}\left[\frac{1+0.76190^2*2.95655}{1+2.95655}\right] = \pm\ 22243.4\ PSI, 153.363\ MPa$ ❹

Long Side Plates:

$(S_t)_M = \pm \frac{P*h^2*c_2}{12I_2*e_b}\left[1.5 - \frac{1+\alpha^2K}{1+K}\right] = \pm \frac{1800*5.2500^2*0.68750}{12*0.2166341*0.48773}\left[1.5 - \frac{1+0.76190^2*2.95655}{1+2.95655}\right] = \pm\ 21883.5\ PSI, 150.881\ MPa$ ❺

$(S_t)_Q = \pm \frac{P*h^2*c_2}{12I_2}\left[\frac{1+\alpha^2K}{1+K}\right] = \pm \frac{1800*5.2500^2*0.68750}{12*0.2166341}\left[\frac{1+0.76190^2*2.95655}{1+2.95655}\right] = \pm\ 9007.7\ PSI, 62.106\ MPa$ ❻

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***Combined Stress (Not to Exceed 30000 PSI)***

Short Side Plates:

$(S_T)_N$ = ❶ + ❸ = 5400.0 PSI, 37.232 MPa + 5968.8 PSI, 41.153 MPa = 11368.8 PSI, 78.385 MPa ❼

$(S_T)_Q$ = ❶ + ❹ = 5400.0 PSI, 37.232 MPa + 22243.4 PSI, 153.363 MPa = 27643.4 PSI, 190.595 MPa ❽

Long Side Plates:

$(S_T)_M$ = ❷ + ❺ = 5368.1 PSI, 37.011 MPa + 21883.5 PSI, 150.881 MPa = 27251.6 PSI, 187.893 MPa ❾

$(S_T)_Q$ = ❷ + ❻ = 5368.1 PSI, 37.011 MPa + 9007.7 PSI, 62.106 MPa = 14376 PSI, 99.117 MPa ❿

***End Plate Thickness (Per UG-34)***

Where $T_M$ = Minimum Thickness

$$T_M = C.A. + H * \sqrt{\left[\left(3.4 - 2.4 * \frac{H}{h}\right) * \left(\frac{0.2 * P}{S}\right)\right]}$$

$T_M =$ Error! Reference source not found. +Error! Reference source not found.$* \sqrt{\left[\left(3.4 - 2.4 * \frac{2.0000}{5.2500}\right) * \left(\frac{0.2 * 1800}{20000}\right)\right]}$

= 0.673 In, 17.087 mm

End Plate Thickness Selected by Program: 0.875 In, 22.225 mm

***Pipe and Tube Stresses***

Where $T_E$ = Effective Thickness
$T_A$ = Actual Thickness
$D_0$ = Pipe or Tube Outer Diameter
$R_0$ = Pipe or Tube Outer Radius
$T_M$ = Minimum Thickness
S = Stress

Nozzle 1 (1.900 inch O.D. X 0.200 in Thick Inlet Pipe, SA-106-GR B):
Allowable Stress: Not to Exceed 17100.0 PSI, 117.905 MPa

$T_E = (T_A \times 0.875) - C.A. = (0.2000 \times 0.875) - 0.000 = 0.1750$ in, 4.4450 mm

$R_0 = D_0/2 = 1.9000/2 = 0.9500$

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = 1800\left(\frac{0.9500}{0.1750} - 0.4\right) = 9051.429\ PSI\ \ 62.410\ MPa$$

Nozzle 2 (2.375 inch O.D. X 0.218 in Thick Outlet Pipe, SA-106-GR B):
Allowable Stress: Not to Exceed 17100.0 PSI, 117.905 MPa

$T_E = (T_A \times 0.875) - C.A. = (0.2180 \times 0.875) - 0.000 = 0.1907$ in, 4.8450 mm

$R_0 = D_0/2 = 2.3750/2 = 1.1875$

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = 1800\left(\frac{1.1875}{0.1907} - 0.4\right) = 10485.767\ PSI\ \ 72.299\ MPa$$

Nozzle 3 (Not applicable, Nozzle 3 does not exist for this section):
Allowable Stress: Not applicable

$T_E$ = ($T_A$ x 0.875) – C.A. = (Not applicable x 0.875) – 0.000 = Not applicable

$R_0$ = $D_0$/2 = Not applicable/2 = Not applicable

$$S = P\left(\frac{R_0}{T_E} - 0.4\right) = Not\ applicable\left(\frac{Not\ applicable}{Not\ applicable} - 0.4\right) =$$

Tubes (SA214(WLD)):
Tube Allowable Stress: 11400 PSI, 78.6 Mpa

$T_M = \frac{P*0.5*D_O}{S+0.4*P} = \frac{1800*0.5*0.625}{11400+0.4*1800}$ = 0.046 In, 1.179 mm

Tube Wall Thickness Selected by Program: 0.060 In, 1.524 mm

---

Calculations Generated By: Name

# Section 7: Manufacture Contacts


General Sales & Customer Service
Alfa Laval Inc.
1020 E Nashville Street
Broken Arrow, OK 74012

ACE.Sales@alfalaval.com
Phone: 918-251-7477

Parts and Service:
Alfa Laval Inc.
1020 E Nashville Street
Broken Arrow, OK 74012

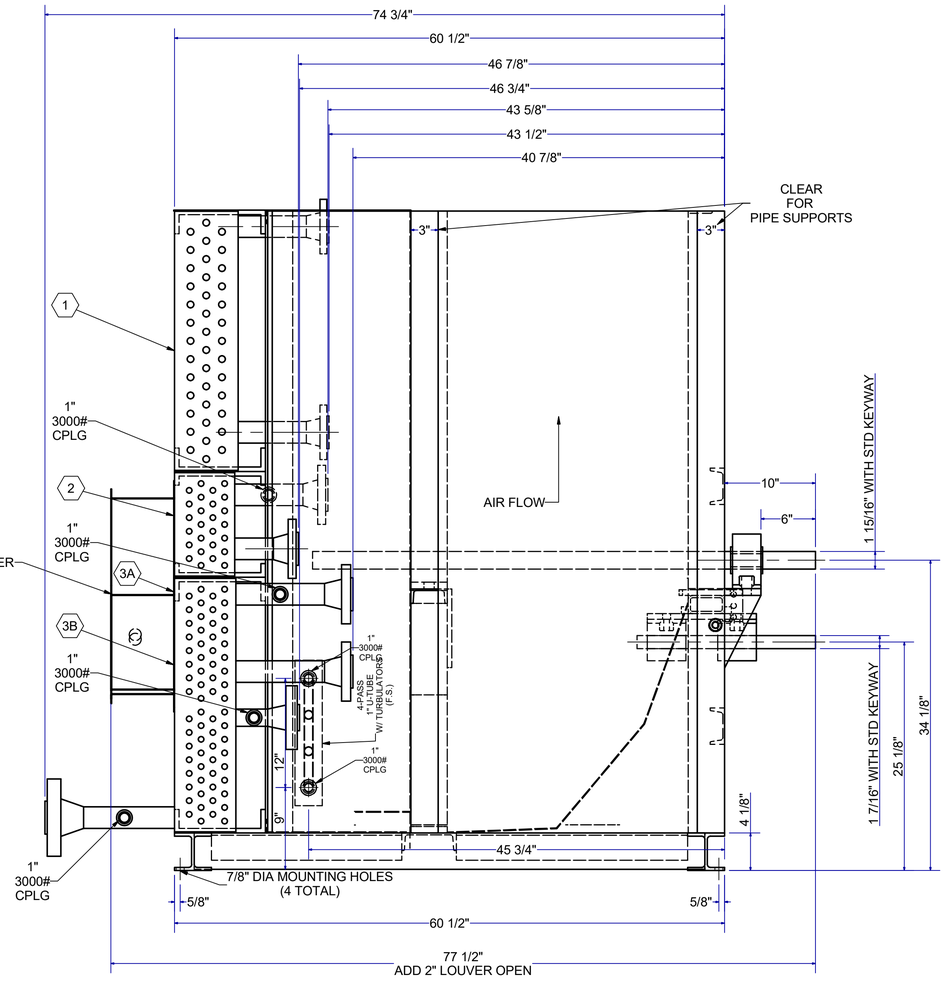
ACE.PartsOrders@alfalaval.com
Phone: 918-505-3662

US Corporate Office
Alfa Laval Inc.
5400 International Trade Drive
Richmond, VA 23231

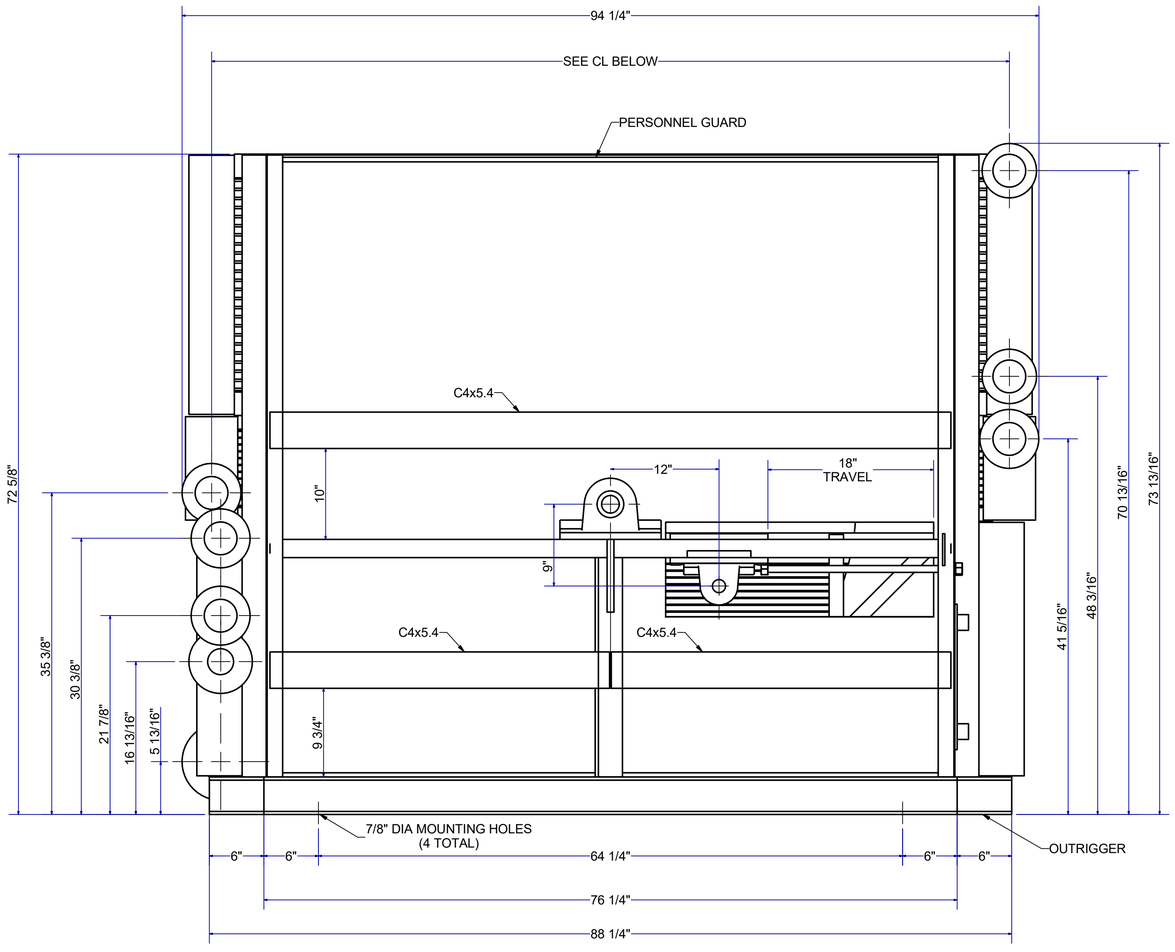
Phone: 804-222-5300
Fax: 804-236-3276

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **HEAT EXCHANGER ACE Model J54 Cooler** | | | |
| | | | | Customer Purchase Order No. | 0019620-03 | Serial No. | ACE1826322 |
| Sales Order No. | 0 | Manufacturer Order No. | ACE1826322 | McClung Energy Services, LLC | | | |

# Section 8: STEP File




SIDE ELEVATION




SHAFT END ELEVATION

NOTES

1. WEIGHT: 3803 POUNDS
2. FINISH: ACE std prep. w/ one coat ACE std primer
3. FAN DRIVEN BY V-Belt Drive By Others
4. ASME CODE WITH NATIONAL BOARD ON IC1,IC2,AC,
5. PERSONNEL GUARD, ARE TO BE GALVANIZED STEEL ONLY (1)

"The 2015 Edition of ASME Section VIII, Div 1 requires hydrostatic testing of headers/sections prior to coating application. However, ACE's standard practice requires that the initial application of header coating precedes hydrostatic testing. Through the approval of this drawing, you (the customer) acknowledge and approve of this deviation from current ASME Section VIII, Div 1 requirements."

SEE CL BELOW - THESE DIMENSION (S) ARE SYMETRICAL ABOUT THE CENTER OF COOLER.

| FLAG | SERVICE | CL | LOUVERS | DESIGN PRESSURE | DESIGN TEMPERATURE | NOZZLES IN | NOZZLES OUT | OTHER NOZZLE | NC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | EJW | 87.75 | N/A | 100 PSI | 350 Deg F/-20 Deg F | (1)2-150RF | (1)2-150RF | N/A | N/A |
| 2 | IC1 | 87.75 | MANUAL | 645 PSI | 350 Deg F/-20 Deg F | (1)2-300RF | (1)2-300RF | N/A | N/A |
| 3A | IC2 | 85.75 | W/IC1 | 1287 PSI | 350 Deg F/-20 Deg F | (1)2-600RF | (1)2-600RF | N/A | N/A |
| 3B | AC | 85.75 | W/IC1 | 1800 PSI | 350 Deg F/-20 Deg F | (1)1.5-900RF | (1)2-900RF | N/A | N/A |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

UNIT: 1826301-27
TAG: 990010042-01
JOB: 18263

RPM= 848
HP= 7 PER FAN
BLADE ANGLE= 37

# AIR COOLED EXCHANGERS

SCALE: 1:1 (FIT TO PLOT)
DATE: 10/30/2018
ACE MODEL J54-7
DRAWN BY: AID
CHECKED BY:
CUSTOMER: McClung Energy
P.O: 0020014-01

| | BY | DATE | DESCRIPTION | CK'D |
|---|---|---|---|---|
| 0 | CK | 11/1/18 | SEE 17137 FOR STRUCTURE | |
| 1 | CK | 11/1/18 | REV NOTE 5. | |

DRAWING NUMBER 18263 -C
REV 1