

BOILER SPECIFICATION CARD

Locomotive No. Anaka; Boiler No. 548; Date built August 1985
 Boiler built by: Western Metal Products
 Owned by: Railroads of Hawaii, Inc.
 Operated by: Railroads of Hawaii, Inc. - dba Lahaina, Kaanapali + Pacific RR
 Type of boiler: Straight Top Radial, Stayed; Dome, where located: 2nd Course

BOILER SURVEY DATA

Where condition is called for, use: **New** - New material at the time of the boiler survey; **Good** - Little or no wear and/or corrosion; **Fair** - Obvious wear and/or corrosion.

Boiler Shell Sheets

Material:	Type of Material <small>(wrought iron, carbon steel, or alloy steel)</small>	Carbon Content	Condition
1st course (front)	<u>SA 515 Gr 70</u>	<u>.26</u>	<u>Good</u>
2nd course	<u>SA 515 Gr 70</u>	<u>.26</u>	<u>Good</u>
3rd course			
Rivets		<u>n/a</u>	<u>n/a</u>

Documentation of how material was determined shall be attached to this form.

Measurements:

	At Seam	Thinnest		
Front flue sheet, thickness	<u>n/a</u>	<u>.508</u>		
1st course, thickness	<u>.524</u>	<u>.502</u>	ID <u>42 1/8"</u>	ID _____
2nd course, thickness	<u>.529</u>	<u>.514</u>	ID <u>42 1/8"</u>	ID _____
3rd course, thickness	<u>N/E</u>		ID _____	ID _____

When courses are not cylindrical give ID at each end

Is boiler shell circular at all points? Yes

If shell is flattened, state location and amount _____

Are all flattened areas of shell stayed adequately for the pressure allowed by this form? _____

Water Space at Mud Ring: Sides 2 1/2", Front 2 1/2", Back 2 1/2"

Width of water space at sides of fire box measured at center line of boiler: Front 3", Back 3"

Firebox and Wrapper Sheets

Firebox sheets:	Thickness	Material	Condition
Rear flue sheet	<u>.750</u>	<u>SA 516 Gr 70</u>	<u>Good</u>
Crown	<u>.513</u>	<u>SA 285 Gr C / SA 516 Gr 70</u>	<u>Good</u>
Sides	<u>.514</u>	<u>SA 285 Gr C / SA 516 Gr 70</u>	<u>Good</u>
Door	<u>.530</u>	<u>SA 285 Gr C</u>	<u>Good</u>
Combustion chamber	<u>N/E</u>		
Inside throat	<u>N/E</u>		

Wrapper sheets:

Throat	<u>.547</u>	<u>SA 285 Gr C</u>	<u>Good</u>
Back head	<u>.533</u>	<u>SA 515 Gr 70</u>	<u>Good</u>
Roof	<u>.525</u>	<u>SA 515 Gr 70</u>	<u>Good</u>
Sides	<u>.525</u>	<u>SA 515 Gr 70</u>	<u>Good</u>
Front Tube	<u>.519</u>	<u>SA 285 Gr C</u>	<u>Good</u>

Steam Dome

Dome is made of 2 pieces (not including seam welts, if any), Top opening diameter 14.5"
 Middle cylindrical portion - ID 20.25", Opening in boiler shell, longitudinally - 20.25"

Dome sheets:	Thickness	Material	Condition
Base	<u>N/E</u>		
Middle cylindrical portion	<u>.375</u>	<u>SA 285 Gr C</u>	<u>Good</u>
Top	<u>1.250</u>	<u>SA 285 Gr C</u>	<u>Good</u>
Lid	<u>1.750</u>	<u>SA 516 Gr 70</u>	<u>Good</u>
Boiler shell liner for steam dome opening:	<u>.370</u>	<u>SA 285 Gr C</u>	<u>Good</u>
Is liner part of longitudinal seam?	<u>No</u>		

Arch Tubes, Flues, Circulators, Thermic Siphons, Water Bar Tubes, Superheaters, and Dry Pipe

Arch tubes: OD N/E, wall thickness _____; number _____; condition _____

Flues:

OD 2", wall thickness .95, length 108.5"; number 96; condition New 4/2010
 OD _____, wall thickness _____, length _____; number _____; condition _____
 OD _____, wall thickness _____, length _____; number _____; condition _____

Circulators: OD N/E, wall thickness _____; number _____; condition _____

Thermic siphons: number N/E; plate thickness _____; condition _____
 neck OD _____, neck thickness _____; condition _____

Water bar tubes: OD N/E, wall thickness _____

Superheater units directly connected to boiler with no intervening valve:

Type N/E, Tube OD _____, wall thickness _____; number _____; condition _____

Dry pipe subject to pressure:

OD 3.5", wall thickness .235, material SA 106; condition Good

Stay Bolts, Crown Bar Rivets, and Braces

Stay bolts:

Smallest crown stay diameter 1.0, avg. spacing 5" X 5"; condition Good
 ** Smallest stay bolt diameter 1.0, avg. spacing 5.5" X 5.625"; condition Good
 Smallest combustion chamber stay bolt dia. N/E,
 avg. spacing _____ X _____; condition _____

Measurement at smallest diameter

Crown bar bolts & rivets:

Roof sheet rivets, smallest dia. N/E, ave. spacing _____ X _____; condition _____
 Roof sheet bolts, smallest dia. N/E, ave. spacing _____ X _____; condition _____
 Crown sheet rivets, smallest dia. N/E, ave. spacing _____ X _____; condition _____
 Crown sheet bolts, smallest dia. N/E, ave. spacing _____ X _____; condition _____

Braces: Total Cross Sectional Area of Braces

** Note: Because of Mud Ring of welded construction, bottom row of staybolts in firebox are 1.250" Diameter which supports an area of 7.562" x 6".

	Number	Total Area Stayed	Actual	Equivalent Direct Stay
Backhead	12 @ 1 1/4" D	451.74 in sq	14.726 in sq	13.586 in sq
Throat sheet	5 @ 1 1/8" D	102.3 in sq	4.97 in sq	4.97 in sq
Front tube sheet	14 @ 1 1/4" D	445 in sq	17.178 in sq	15.617 in sq
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Safety Valves, Heating Surface, and Grate Area

Safety valves:	Total number of safety valves on locomotive <u>2</u>	
Valve Size	Manufacturer	No. valves of this size and manufacture
<u>1 1/4"</u>	<u>Kunkle</u>	<u>2</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

Heating Surface:

Heating surface, as part of a circulating system in contact on one side with water or wet steam being heated and on the other side with gas or refractory being cooled, shall be measured on the side receiving heat.

Firebox and Combustion Chamber	<u>41.86</u>	square feet
Flue Sheets (less flue ID areas)	<u>15.86</u>	square feet
Flues	<u>404.9</u>	square feet
Circulators	_____	square feet
Arch Tubes	_____	square feet
Thermic Siphons	_____	square feet
Water Bar Tubes	_____	square feet
Superheaters (front end throttle only)	_____	square feet
Other	_____	square feet
Total Heating Surface	<u>462.62</u>	square feet

Grate area: 9.94 square feet

Water Level Indicators, Fusible Plugs, and Low Water Alarms

Height of lowest reading of gauge glasses above crown sheet: 3 1/4" 3 1/4"

Height of lowest reading of gauge cocks above crown sheet: 3 1/4"

Is boiler equipped with fusible plug(s)? Yes, number 2

Is boiler equipped with low water alarm(s)? No, number _____

Calculations

Staybolt stresses:

Stay bolt under greatest load, maximum stress 7160 psi
 Location Backhead + 0 Doorsheet
 Crown stay, crown bar rivet, or crown bar bolt under greatest load, max. stress 6610 psi
 Location Front Transverse Row
 Combustion chamber stay bolt under greatest load, maximum stress N/E psi
 Location _____

Braces:

Round or rectangular brace under greatest load, maximum stress 5985 psi
 Location Backhead
 Gusset brace under greatest load, maximum stress N/E psi
 Location _____

Shearing stress on rivets:

Greatest shear stress on rivets in longitudinal seam N/E psi
 Location (course #) _____ ; Seam Efficiency _____

Boiler shell plate tension:

Greatest tension on net section of plate in longitudinal seam 8425 psi
 Location (course #) 1st + 2nd ; Seam Efficiency .9

.9 used for welded seam not having reinforcement ground smooth.

Boiler plate and components, minimum thickness required @ tensile strength:

Front tube sheet	<u>.462 @ 55000</u>	Rear flue sheet	<u>.342 @ 70000</u>
1st course at seam	<u>.245 @ 70000</u>	1st course not at seam	<u>.220 @ 70000</u>
2nd course at seam	<u>.245 @ 70000</u>	2nd course not at seam	<u>.220 @ 70000</u>
3rd course at seam	<u>N/E @</u>	3rd course not at seam	<u>N/E @</u>
Roof sheet	<u>.220 @ 70000</u>	Crown sheet	<u>.384 @ 55000</u>
Side wrapper sheets	<u>.410 @ 70000</u>	Firebox side sheets	<u>.433 @ 55000</u>
Back head	<u>.384 @ 70000</u>	Door sheet	<u>.433 @ 55000</u>
Throat sheet	<u>.384 @ 55000</u>	Inside throat sheet	<u>N/E @</u>
Combustion chamber	<u>N/E @</u>	Dome, top	<u>1.149 @ 55000</u>
Dome, middle	<u>.151 @ 55000</u>	Dome, base	<u>N/E @</u>
Arch tubes	<u>N/E @</u>	Dome, lid	<u>1.443 @ 70000</u>
Water bar tubes	<u>N/E @</u>	Thermic siphons	<u>N/E @</u>
Dry pipe	<u>.092 @ 34600</u>	Circulators	<u>N/E @</u>

- Notes. 1. If tensile strength used is greater than 50,000 psi for steel or greater than 45,000 psi for wrought iron, supporting documentation must be furnished.
2. Any shell dimension less than 1/4" in thickness may not be adequate for support of or by other structures, particularly where threads or staybolts are concerned. Applicable codes should be consulted.

Boiler Steam Generating Capacity: 6476.68 pounds per hour

The following may be used as a guide for estimating steaming capacity:

Pounds of Steam Per Hour Per Square Foot of Heating Surface:

Hand fired	8 lbs. per hr.
Stoker fired	10 lbs. per hr.
Oil, gas or pulverized fuel fired	14 lbs. per hr.

Record of Alterations

Description of Alteration

Date of Alteration

