

TO: AUTHORIZED INSPECTOR
HSB CT.

DATE: 17-DEC-04

SUBJECT: TRANSMITTAL OF ASME SUBMITTAL CALCULATIONS FOR A.I. ACCEPTANCE

GENTLEMEN:

ATTACHED ARE ASME PRESSURE VESSEL CODE CALCULATIONS ACCORDING TO THE 2001 EDITION, 2003 ADDENDA OF SECTION VIII, DIVISION 1, OF THE ASME CODE. THE CALCULATIONS SUPPORT THE DESIGN OF THE FOLLOWING VESSEL.

ASSEMBLY DRAWING -----	SALES ORDER -----	CUSTOMER -----
15773A REV A	509.3	AL-DEUTSCHLAND

LOADINGS LISTED IN UG-22 HAVE BEEN CONSIDERED IN THE DESIGN OF THE VESSEL AND THE CUSTOMER ADVISED OF THE MAXIMUM LOADS THAT MAY BE APPLIED. YOUR ACCEPTANCE OF THESE CALCULATIONS AND THE VESSEL DESIGN AS MEETING THE MINIMUM REQUIREMENTS OF THE ASME CODE, SECTION VIII, DIV. 1, IS RESPECTFULLY REQUESTED. PLEASE ACKNOWLEDGE YOUR ACCEPTANCE BY SIGNING AND DATING THIS FORM IN THE SPACE PROVIDED.

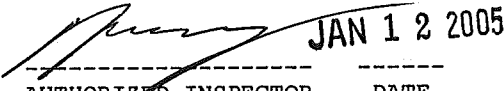
BEST REGARDS,



PRODUCT ENGINEERING
CHART HEAT EXCHANGERS

A.I. ACCEPTANCE

I HAVE REVIEWED THE CALCULATIONS AND THE ABOVE LISTED DRAWING. IN MY OPINION THIS DESIGN DOES MEET THE MINIMUM REQUIREMENTS OF THE ASME CODE SECTION VIII, DIV. 1



AUTHORIZED INSPECTOR DATE
HSB CT.

JAN 12 2005

SUBJECT: ASME SUBMITTAL CALCULATIONS PER THE 2001 EDITION,
2003 ADDENDA OF SECTION VIII, DIVISION 1.CUSTOMER: AL-DEUTSCHLAND
SALES ORDER: 509.3
ASSEMBLY DRAWING: 15773A REV A
ITEM: W40001

DESIGN BASIS:

- CODE JURISDICTION ENDS AT FIRST NOZZLE CIRCUMFERENTIAL WELD JOINT.
- MAXIMUM DESIGN TEMPERATURE= 150. DEGREES F
- CORROSION ALLOWANCE: NONE
- ASME CODE REQUIRED RADIOGRAPHY:

NONE.

FIN DESIGN:

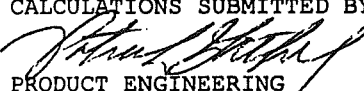
THE MAXIMUM ALLOWABLE DESIGN PRESSURE OF THE FINS USED IN THIS HEAT EXCHANGER MEET OR EXCEED THE STREAM DESIGN PRESSURE. THE RATINGS WERE CALCULATED PER PARAGRAPH U-2(G). THE PROPRIETARY CALCULATION METHOD WAS APPROVED BY CHART AND REVIEWED AND ACCEPTED BY HSB CT.

PIPING DESIGN:

CONNECTION	HEADER			NOZZLE			DESIGN PRESSURE P.S.I.G.
	O.D. X	WALL X	MATERIAL	O.D. X	WALL X	MATERIAL	
	IN. X	IN.		IN. X	IN.		
A IN	22.500	0.500	SB-209-5083	20.000	0.500	SB-209-5083	61.
A OUT	13.000	0.375	SB-209-5083	10.750	0.365	SB-241-5083	61.
A VENT				1.315	0.133	SB-241-5083	61.

NOTE: PER UG-36(C)(3)(a), REINFORCEMENT CALCULATIONS ARE NOT
MADE FOR 2" NPS NOZZLES OR SMALLER.NOTE: A STREAM DESIGN PRESSURE INCREASED BY A FACTOR OF 1.50/1.10
TO ACCOUNT FOR ELEVATED PNEUMATIC TEST PRESSURE.

CALCULATIONS SUBMITTED BY:


PRODUCT ENGINEERING
CHART HEAT EXCHANGERS

CHECKED BY:


PRODUCT ENGINEERING
CHART HEAT EXCHANGERS

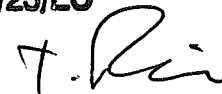
Reviewed

TÜV SÜddeutschland'Bay und Betrieb GmbH

Notified Body for Pressure

Equipment Directive 97/23/EC

-Testing Laboratory- FEB 01 2005



HEADER OPENING AND REINFORCING CALCULATION
PER ASME SECTION VIII, DIV 1., PAR UG-36,UG-40,AND UG-42
(NOZZLE ABUTTS THE HEADER BODY, REF FIG UW-16.1(a))

STREAM	A IN
DESIGN PRESSURE (P)	61. PSIG
HEADER SIZE (O.D.)	22.500 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.500 INCHES
INSIDE RADIUS (R)	10.750 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.058 INCHES
NOZZLE SIZE (O.D.)	20.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (TN)	0.500 INCHES
INSIDE DIAMETER (D)	19.000 INCHES
INSIDE RADIUS (R)	9.500 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.051 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.354 INCHES
ACTUAL WELD LEG (W)	0.500 INCHES

REINFORCEMENT CALCULATION UG-37

AVAILABLE AREA	
SHELL: LARGER OF: (NOTE 1)	E1=1.00
A1A $D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	8.404 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 5(TN-TRN)(FR2)(TN)	1.123 IN2
ADDITIONAL AREA IF USED (RE-PAD OR INWARD NOZZLE)	
A3 $(DP - D - 2TN)TE(FR4)$ OR $2(TN)FR2 \cdot H$	0.000 IN2
WELD AREA	
A4 $W \cdot W \cdot (FR2)$	0.250 IN2
ATOT $ATOT = A1 + A2 + A3 + A4$	9.776 IN2
REQUIRED AREA	
$AREQ = D \cdot TR \cdot F + 2 \cdot TN \cdot TR \cdot F(1 - FR1)$ (F=1.0)	1.096 IN2

REINFORCEMENT CALCULATION APPENDIX (1-7a). (NOTE 2) $R_n/R = 0.88$

A1(1-7) = LARGER OF A1(1-7)A OR A1(1-7)B	
A1(1-7)A $.5 \cdot D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1(1-7)B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	4.202 IN2
ATOT(1-7) = A1(1-7) + A2 + A3 + A4	5.574 IN2
AREQ(1-7) = (2/3) X AREQ	0.731 IN2

- (1) E1 NORMALLY EQUALS 1.0. WHEN THE NOZZLE PASSES THROUGH A CATEGORY A WELD JOINT E1 IS TAKEN FROM TABLE UW-12.
- (2) REFERENCE PAR. UG-36(B-1). THIS CALCULATION IS REQUIRED WHEN THE OPENING IS GREATER THAN HALF THE HEADER I.D. OR THE OPENING EXCEEDS 20 INCHES.
- (3) $FR1 = 1.0$ OR SN/SV FOR INSERTED NOZZLES.
 $FR2 = SN/SV$, $FR3 = (\text{LESSER OF } SN \text{ OR } SP)/SV$, $FR4 = SP/SV$.
- (4) TR & TRN ARE BASED ON SEAMLESS MATERIAL PER DEFINITIONS IN UG-37.

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom / Review date:

FEB 01 2005



HEADER OPENING AND REINFORCING CALCULATION
PER ASME SECTION VIII, DIV 1., PAR UG-36,UG-40,AND UG-42
(NOZZLE ABUTTS THE HEADER BODY, REF FIG UW-16.1(a))

STREAM	A OUT
DESIGN PRESSURE (P)	61. PSIG
HEADER SIZE (O.D.)	13.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.375 INCHES
INSIDE RADIUS (R)	6.125 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.033 INCHES
NOZZLE SIZE (O.D.)	10.750 INCHES
MATERIAL	SB-241-5083-0
ALLOWABLE STRESS (S)	10700. PSI
WALL THICKNESS (TN)	0.365 INCHES
INSIDE DIAMETER (D)	10.020 INCHES
INSIDE RADIUS (R)	5.010 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.029 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.354 INCHES
ACTUAL WELD LEG (W)	0.365 INCHES

REINFORCEMENT CALCULATION UG-37

AVAILABLE AREA	
SHELL: LARGER OF: (NOTE 1)	E1=1.00
A1A $D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	3.428 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 5(TN-TRN)(FR2)(TN)	0.576 IN2
ADDITIONAL AREA IF USED (RE-PAD OR INWARD NOZZLE)	
A3 $(DP - D - 2TN)TE(FR4) \text{ OR } 2(TN)FR2 \cdot H$	0.000 IN2
WELD AREA	
A4 $W \cdot W \cdot (FR2)$	0.125 IN2
ATOT $ATOT = A1 + A2 + A3 + A4$	4.129 IN2
REQUIRED AREA	
$AREQ = D \cdot TR \cdot F + 2 \cdot TN \cdot TR \cdot F(1 - FR1)$ (F=1.0)	0.329 IN2

REINFORCEMENT CALCULATION APPENDIX (1-7a). (NOTE 2) $Rn/R = 0.82$

A1(1-7) = LARGER OF A1(1-7)A OR A1(1-7)B	
A1(1-7)A $.5 \cdot D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1(1-7)B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	1.714 IN2
ATOT(1-7) = A1(1-7) + A2 + A3 + A4	2.415 IN2
$AREQ(1-7) = (2/3) \cdot X \cdot AREQ$	0.220 IN2

- (1) E1 NORMALLY EQUALS 1.0. WHEN THE NOZZLE PASSES THROUGH A CATEGORY A WELD JOINT E1 IS TAKEN FROM TABLE UW-12.
- (2) REFERENCE PAR. UG-36(B-1). THIS CALCULATION IS REQUIRED WHEN THE OPENING IS GREATER THAN HALF THE HEADER I.D. OR THE OPENING EXCEEDS 20 INCHES.
- (3) FR1=1.0 OR SN/SV FOR INSERTED NOZZLES.
FR2=SN/SV, FR3=(LESSER OF SN OR SP)/SV, FR4=SP/SV.
- (4) TR & TRN ARE BASED ON SEAMLESS MATERIAL PER DEFINITIONS IN UG-37.

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom / Review date:

FEB 01 2005

T. R.

ASME REQUIREMENTS FOR ALUMINUM FLAT UNSTAYED DISKS

DISK DESIGN FOR A IN NOZZLE 20.000 INCH O.D. BY 0.500 INCH WALL

DESIGN PRESSURE = 61. PSIG
OUTSIDE DIAMETER OF PIPE = 20.000 INCHES
WALL THICKNESS OF PIPE = 0.500 INCHES
INSIDE DIAMETER OF PIPE (D) = 19.000 INCHES
PIPE MATERIAL = SB-209-5083-0 ALUMINUM
ALLOWABLE STRESS OF PIPE = 11400. PSI
DISK MATERIAL = SB-209-5083-0 ALUMINUM
ALLOWABLE STRESS OF DISK = 11400. PSI
THE DISK IS WELDED WITH A BACKING RING.

FACTOR FOR HEAD ATTACHMENT (C) = .33 PER FIG UG-34 (H)
JOINT EFFICIENCY (E) = 1.0 FOR SEAMLESS DISKS

PER UG-34 (C) (2), SECTION VIII, DIVISION 1, OF THE ASME CODE:

$$T_{MIN}(1) = D \cdot \text{SQRT OF } (CP/SE) = 0.798 \text{ INCHES}$$

PER FIG UW-13.2 (C): $T_{MIN}(2) = TP + B$

WHERE: TP = THE SMALLER OF TN OR .25
B = TN FOR DISKS BEVELED AT A 45 DEGREE ANGLE

$$T_{MIN}(2) = 0.750 \text{ INCHES}$$

WHEN A DISK CLOSURE IS USED A CHECK MUST BE MADE ON THE REQUIRED PIPE WALL THICKNESS. TO COMPLY WITH FIG UG-34 (H), A NOZZLE THICKNESS OF 1.25 (TR) IS REQUIRED.

PER UG-27 (C) (1):

$$TR = PR / (SE - .6P)$$

THUS THE MINIMUM REQUIRED NOZZLE THICKNESS IS:

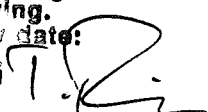
$$TR = 1.25PR / (SE - .6P) = 0.064 \text{ INCHES}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.500 \text{ INCHES} - 0.032 \text{ INCH M.T.} = 0.468 \text{ INCHES}$$

SINCE THE DISK THICKNESS 0.945 IN. (1.000 IN - 0.055 IN M.T.), MEETS OR EXCEEDS $T_{MIN}(1)$ AND $T_{MIN}(2)$ AND THE ACTUAL PIPE WALL THICKNESS EXCEEDS 1.25 (TR) THE DESIGN MEETS THE MINIMUM REQUIREMENTS OF THE ASME CODE.

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom / Review date:

FEB 01 2005



ASME REQUIREMENTS FOR ALUMINUM FLAT UNSTAYED DISKS

DISK DESIGN FOR A OUT NOZZLE 10.750 INCH O.D. BY 0.365 INCH WALL

DESIGN PRESSURE = 61. PSIG
OUTSIDE DIAMETER OF PIPE = 10.750 INCHES
WALL THICKNESS OF PIPE = 0.365 INCHES
INSIDE DIAMETER OF PIPE (D) = 10.020 INCHES
PIPE MATERIAL = SB-241-5083-0 ALUMINUM
ALLOWABLE STRESS OF PIPE = 10700. PSI
DISK MATERIAL = SB-209-5083-0 ALUMINUM
ALLOWABLE STRESS OF DISK = 11400. PSI
THE DISK IS WELDED WITH A BACKING RING.

FACTOR FOR HEAD ATTACHMENT (C) = .33 PER FIG UG-34(H)
JOINT EFFICIENCY (E) = 1.0 FOR SEAMLESS DISKS

PER UG-34(C) (2), SECTION VIII, DIVISION 1, OF THE ASME CODE:

$$T_{MIN}(1) = D \times \text{SQUARE ROOT OF } (C/P/SE) = 0.421 \text{ INCHES}$$

PER FIG UW-13.2(C): $T_{MIN}(2) = TP + B$

WHERE: TP = THE SMALLER OF TN OR .25
B = TN FOR DISKS BEVELED AT A 45 DEGREE ANGLE

$$T_{MIN}(2) = 0.615 \text{ INCHES}$$

WHEN A DISK CLOSURE IS USED A CHECK MUST BE MADE ON THE REQUIRED PIPE WALL THICKNESS. TO COMPLY WITH FIG UG-34(H), A NOZZLE THICKNESS OF 1.25(TR) IS REQUIRED.

PER UG-27(C) (1):

$$TR = PR / (SE - .6P)$$

THUS THE MINIMUM REQUIRED NOZZLE THICKNESS IS:

$$TR = 1.25PR / (SE - .6P) = 0.036 \text{ INCHES}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.365 \text{ INCHES} \times .875 = 0.319 \text{ INCHES}$$

SINCE THE DISK THICKNESS 0.707 IN. (0.750 IN - 0.043 IN M.T.), MEETS OR EXCEEDS $T_{MIN}(1)$ AND $T_{MIN}(2)$ AND THE ACTUAL PIPE WALL THICKNESS EXCEEDS 1.25(TR) THE DESIGN MEETS THE MINIMUM REQUIREMENTS OF THE ASME CODE.

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom 17.12.04 by date:

FEB 01 2005

T. J. E.

SUBJECT: EXTERNAL PRESSURE CALCULATIONS FOR THE FINS AND PIPING

CUSTOMER: AL-DEUTSCHLAND
SALES ORDER: 509.3
ASSEMBLY DRAWING: 15773A REV A
ITEM: W40001

DESIGN BASIS:

- CODE JURISDICTION ENDS AT FIRST NOZZLE CIRCUMFERENTIAL WELD JOINTS PAST THE HEADER TO NOZZLE JOINTS.
- DESIGN PRESSURES: A STREAM = 61. PSIG (INTERNAL PRESSURE)
A STREAM = 45. PSIG (EXTERNAL PRESSURE)
B STREAM = NO DIFFERENTIAL PRESSURE

FIN DESIGN (EXTERNAL PRESSURE):

TO ESTABLISH THE MAXIMUM WORKING PRESSURE OF FINS, NUMEROUS FINS WERE EXTERNALLY PRESSURE TESTED TO FAILURE. A CORRELATION WAS DERIVED TO PREDICT THE FAILURE PRESSURE OF ALL FINS. FOR FINS WHICH HAVE BEEN CRUSH TESTED, RATINGS ARE DETERMINED BY DIVIDING THE CRUSH PRESSURES BY 3 AS SPECIFIED IN UG-101(P). OTHER FINS ARE RATED BY DIVIDING THE PREDICTED CRUSH PRESSURE BY 3 AND THEN MULTIPLYING BY A .88 SAFETY FACTOR.

FIN SUMMARY:

STREAM	FIN DIE#	FIN TYPE	FIN HEIGHT	FIN THICK	FINS PER IN	MAXIMUM EXTERNAL WORKING PRESSURE (PSIG)	EXTERNAL DESIGN PRESSURE (PSIG)
A	CT-7216	5.0% PERF	.201	.0080	25.0	304.	> 45.
A	CT-7169	5.0% PERF	.201	.0160	10.5	384.	> 45.

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk von: / Review date:

FEB 01 2005



CALCULATIONS FOR EXTERNAL PRESSURE PER ASME SECTION II, PART D, SUBPART 3

CONNECTION		COMPONENT O.D. X WALL X MATERIAL IN. X IN.	CORROSION ALLOWANCE IN.	MILL TOL IN.	MIN. CORR WALL IN.
A IN	HDR	22.500 0.500 SB-209-5083-0	.0000	.032	0.468
A IN	NOZ	20.000 0.500 SB-209-5083-0	.0000	.032	0.468
A OUT	HDR	13.000 0.375 SB-209-5083-0	.0000	.023	0.352
A OUT	NOZ	10.750 0.365 SB-241-5083-0	.0000	12.5 %	0.319
A VENT	NOZ	1.315 0.133 SB-241-5083-0	.0000	12.5 %	0.116

* OUTSIDE ASME SECTION VIII JURISDICTION BUT INCLUDED FOR REFERENCE ONLY.

EXTERNAL PRESSURE CALCULATIONS

PIPE		MIN. CORR. O.D. WALL (Do) (T) IN. IN.	CHART	Do/T	MAX L IN.	L/Do	FACTOR A*	FACTOR B	MAX EXTERNAL PRESSURE (Pa)**** PSIG	DESIGN PRESS PSIG
A IN	HDR	22.500 0.468	NFA-11-1	48.08	72.	3.2	.001148	4969.	138.>	45.
A IN	NOZ	20.000 0.468	NFA-11-1	42.74	***	50.0	.000651	3305.	103.>	45.
A OUT	HDR	13.000 0.352	NFA-11-1	36.93	72.	5.5	.000969	4528.	163.>	45.
A OUT	NOZ	10.750 0.319	NFA-11-3	33.66	***	50.0	.001049	4166.	165.>	45.
A VENT	NOZ	1.315 0.116	NFA-11-3	11.30	***	50.0	.009307	7436.	877.>	45.

* FROM FIG. G FROM SECTION II PART D

*** LENGTH UNKNOWN. DEPENDENT ON EXTERNAL PIPING SO MAXIMUM
L/Do RATIO USED; L/Do=50

**** PER UG-28 (C) (1): $P_a = \frac{4*B}{3*(Do/T)}$

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom / Review date:

FEB 01 2005



HEADER OPENING AND REINFORCING CALCULATION (FOR EXTERNAL PRESSURE)
PER ASME SECTION VIII, DIV 1., PAR UG-36,UG-40,AND UG-42
(NOZZLE ABUTTS THE HEADER BODY, REF FIG UW-16.1(a))

STREAM	A IN
EXTERNAL DESIGN PRESSURE (P)	45. PSIG
HEADER SIZE (O.D.)	22.500 INCHES
HEADER LENGTH	71.79 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.500 INCHES
INSIDE RADIUS (R)	10.750 INCHES
MINIMUM HEADER THICKNESS PER (ASME SECT. II, SUBPART 3)	
TR (E=1.0 REFERENCE NOTE (4))	0.278 INCHES
NOZZLE SIZE (O.D.)	20.000 INCHES
NOZZLE LENGTH (NOTE 5)	0.00 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (TN)	0.500 INCHES
INSIDE DIAMETER (D)	19.000 INCHES
INSIDE RADIUS (R)	9.500 INCHES
MINIMUM NOZZLE THICKNESS PER (ASME SECT. II, SUBPART 3)	
TRN (E=1.0 REFERENCE NOTE (4))	0.352 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.354 INCHES
ACTUAL WELD LEG (W)	0.500 INCHES

REINFORCEMENT CALCULATION UG-37

AVAILABLE AREA	
SHELL: LARGER OF: (NOTE 1)	E1=1.00
A1A $D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	4.225 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 5(TN-TRN)(FR2)(TN)	0.370 IN2
ADDITIONAL AREA IF USED (RE-PAD OR INWARD NOZZLE)	
A3 $(DP - D - 2TN)TE(FR4)$ OR $2(TN)FR2 \cdot H$	0.000 IN2
WELD AREA	
A4 $W \cdot W \cdot (FR2)$	0.250 IN2
ATOT $ATOT = A1 + A2 + A3 + A4$	4.845 IN2
REQUIRED AREA	
$AREQ = .5 \cdot D \cdot TR \cdot F + 2 \cdot TN \cdot TR \cdot F(1 - FR1)$ (F=1.0)	2.637 IN2

REINFORCEMENT CALCULATION APPENDIX (1-7a). (NOTE 2) $Rn/R = 0.88$

A1(1-7) = LARGER OF A1(1-7)A OR A1(1-7)B	
A1(1-7)A $.5 \cdot D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1(1-7)B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	2.113 IN2
ATOT(1-7) = A1(1-7) + A2 + A3 + A4	2.732 IN2
AREQ(1-7) = (2/3) X AREQ	1.758 IN2

- (1) E1 NORMALLY EQUALS 1.0.
- (2) REFERENCE PAR. UG-36(B-1). THIS CALCULATION IS REQUIRED WHEN THE OPENING IS GREATER THAN HALF THE HEADER I.D. OR THE OPENING EXCEEDS 20 INCHES.
- (3) $FR1 = 1.0$ OR SN/SV FOR INSERTED NOZZLES.
 $FR2 = SN/SV$, $FR3 = (\text{LESSER OF } SN \text{ OR } SP)/SV$, $FR4 = SP/SV$.
- (4) TR & TRN ARE BASED ON SEAMLESS MATERIAL PER DEFINITIONS IN UG-37.
- (5) IF LENGTH=0 (NOT DEFINED) THE MAXIMUM L/Do RATIO IS USED; L/Do=50.

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom / Review date:

FEB 01 2005

T. K.

HEADER AND NOZZLE WALL THICKNESS CALCULATIONS PER APPENDIX 1, PAR. 1-1(a)(1)

NOTE: ALL NOZZLES ARE A MINIMUM OF STD WALL WHICH SATISFIES UG-45(b) REQUIREMENTS

A IN HEADER 22.500 O.D. X 0.500 WALL X SB-209-5083-0 WITH BACKING STRIPS
----- NOZZLE 20.000 O.D. X 0.500 WALL X SB-209-5083-0 TYPE (2) BUTT JOINT
 DESIGN PRESSURE = 61. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= \frac{61. \text{ PSIG} \times 11.250 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 61. \text{ PSIG}} = 0.092 \text{ INCHES} \end{aligned}$$

$$\text{MINIMUM HEADER THICKNESS} = 0.500 \text{ INCHES} - 0.032 \text{ INCH M.T.} = 0.468 \text{ INCHES}$$

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{61. \text{ PSIG} \times 10.000 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 61. \text{ PSIG}} = 0.082 \text{ INCHES} \end{aligned}$$

$$\begin{aligned} \text{MINIMUM NOZZLE THICKNESS} &= 0.500 \text{ INCHES} - 0.032 \text{ INCH M.T.} = 0.468 \text{ INCHES} \\ \text{NOZZLE WALL MACHINED TO } &0.250 \text{ INCHES} > 0.082 \text{ INCHES REQUIRED} \end{aligned}$$

A OUT HEADER 13.000 O.D. X 0.375 WALL X SB-209-5083-0 WITH BACKING STRIPS
----- NOZZLE 10.750 O.D. X 0.365 WALL X SB-241-5083-0 SEAMLESS
 DESIGN PRESSURE = 61. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= \frac{61. \text{ PSIG} \times 6.500 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 61. \text{ PSIG}} = 0.053 \text{ INCHES} \end{aligned}$$

$$\text{MINIMUM HEADER THICKNESS} = 0.375 \text{ INCHES} - 0.023 \text{ INCH M.T.} = 0.352 \text{ INCHES}$$

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{61. \text{ PSIG} \times 5.375 \text{ INCHES}}{10700. \text{ PSI} \times 1.00 + .4 \times 61. \text{ PSIG}} = 0.031 \text{ INCHES} \end{aligned}$$

$$\begin{aligned} \text{MINIMUM NOZZLE THICKNESS} &= 0.365 \text{ INCHES} \times .875 = 0.319 \text{ INCHES} \\ \text{NOZZLE WALL MACHINED TO } &0.158 \text{ INCHES} > 0.031 \text{ INCHES REQUIRED} \end{aligned}$$

A VENT NOZZLE 1.315 O.D. X 0.133 WALL X SB-241-5083-0 SEAMLESS
----- DESIGN PRESSURE = 61. PSIG

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{61. \text{ PSIG} \times 0.658 \text{ INCHES}}{10700. \text{ PSI} \times 1.00 + .4 \times 61. \text{ PSIG}} = 0.004 \text{ INCHES} \end{aligned}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.133 \text{ INCHES} \times .875 = 0.116 \text{ INCHES}$$

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom / Review date:

FEB 01 2005

T. Ka

HEADER OPENING AND REINFORCING CALCULATION (FOR EXTERNAL PRESSURE)
PER ASME SECTION VIII, DIV 1., PAR UG-36,UG-40,AND UG-42
(NOZZLE ABUTTS THE HEADER BODY, REF FIG UW-16.1(a))

STREAM	A OUT
EXTERNAL DESIGN PRESSURE (P)	45. PSIG
HEADER SIZE (O.D.)	13.000 INCHES
HEADER LENGTH	71.79 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.375 INCHES
INSIDE RADIUS (R)	6.125 INCHES
MINIMUM HEADER THICKNESS PER (ASME SECT. II, SUBPART 3)	
TR (E=1.0 REFERENCE NOTE (4))	0.206 INCHES
NOZZLE SIZE (O.D.)	10.750 INCHES
NOZZLE LENGTH (NOTE 5)	0.00 INCHES
MATERIAL	SB-241-5083-0
ALLOWABLE STRESS (S)	10700. PSI
WALL THICKNESS (TN)	0.365 INCHES
INSIDE DIAMETER (D)	10.020 INCHES
INSIDE RADIUS (R)	5.010 INCHES
MINIMUM NOZZLE THICKNESS PER (ASME SECT. II, SUBPART 3)	
TRN (E=1.0 REFERENCE NOTE (4))	0.190 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.354 INCHES
ACTUAL WELD LEG (W)	0.365 INCHES

REINFORCEMENT CALCULATION UG-37

AVAILABLE AREA	
SHELL: LARGER OF: (NOTE 1)	E1=1.00
A1A $D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	1.697 IN2
NOZZLE: SMALLER OF:	
5(TN - TRN)(FR2)(T) OR	
A2 5(TN - TRN)(FR2)(TN)	0.300 IN2
ADDITIONAL AREA IF USED (RE-PAD OR INWARD NOZZLE)	
A3 $(DP - D - 2TN)TE(FR4) \text{ OR } 2(TN)FR2 \cdot H$	0.000 IN2
WELD AREA	
A4 $W \cdot W \cdot (FR2)$	0.125 IN2
ATOT $ATOT = A1 + A2 + A3 + A4$	2.123 IN2
REQUIRED AREA	
$AREQ = .5 \cdot D \cdot TR \cdot F + 2 \cdot TN \cdot TR \cdot F(1 - FR1) \quad (F=1.0)$	1.030 IN2

REINFORCEMENT CALCULATION APPENDIX (1-7a). (NOTE 2) $R_n/R = 0.82$

A1(1-7) = LARGER OF A1(1-7)A OR A1(1-7)B	
A1(1-7)A $.5 \cdot D(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	
A1(1-7)B $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	0.849 IN2
ATOT(1-7) = A1(1-7) + A2 + A3 + A4	1.274 IN2
AREQ(1-7) = (2/3) X AREQ	0.687 IN2

- (1) E1 NORMALLY EQUALS 1.0.
- (2) REFERENCE PAR. UG-36(B-1). THIS CALCULATION IS REQUIRED WHEN THE OPENING IS GREATER THAN HALF THE HEADER I.D. OR THE OPENING EXCEEDS 20 INCHES.
- (3) $FR1 = 1.0$ OR SN/SV FOR INSERTED NOZZLES.
 $FR2 = SN/SV$, $FR3 = (\text{LESSER OF } SN \text{ OR } SP)/SV$, $FR4 = SP/SV$.
- (4) TR & TRN ARE BASED ON SEAMLESS MATERIAL PER DEFINITIONS IN UG-37.
- (5) IF LENGTH=0 (NOT DEFINED) THE MAXIMUM L/Do RATIO IS USED; L/Do=50.

Zur Hauptzeichnung zugehörig.
Belongs to the Main Drawing.
Prüfvermerk vom / Review date:

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