

TO: AUTHORIZED INSPECTOR  
HSB CT.

DATE: 08-FEB-05

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

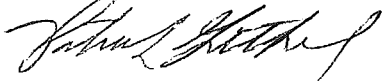
GENTLEMEN:

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 -----
15771A REV A	509.9	AL-DEUTSCHLAND (MESSER)

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,

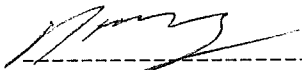


PRODUCT ENGINEERING  
CHART HEAT EXCHANGERS

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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

 2-18-05  
-----  
AUTHORIZED INSPECTOR      DATE  
HSB CT.

SUBJECT: ASME SUBMITTAL CALCULATIONS PER THE 2001 EDITION,  
2003 ADDENDA OF SECTION VIII, DIVISION 1.

CUSTOMER: AL-DEUTSCHLAND (MESSER)  
SALES ORDER: 509.9  
ASSEMBLY DRAWING: 15771A REV A  
ITEM: W23001

## 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 IN. X IN.	WALL X IN.	MATERIAL	O.D. X IN. X IN.	WALL X IN.	MATERIAL	
A IN/OUT	13.670	0.250	SB-209-5083	6.625	0.280	SB-241-5083	198.
B IN&OUT	11.000	0.250	SB-209-5083	4.500	0.237	SB-241-5083	198.
C IN	11.000	0.250	SB-209-5083	6.625	0.280	SB-241-5083	198.
C OUT	13.000	0.250	SB-209-5083	6.625	0.280	SB-241-5083	198.
D IN	48.550	0.375	SB-209-5083	16.000	0.250	SB-209-5083	29.
D OUT	48.550	0.375	SB-209-5083	20.000	0.250	SB-209-5083	29.
E IN				20.000	0.250	SB-209-5083	29.
E OUT				24.000	0.250	SB-209-5083	29.

NOTE: A,B,C STREAM DESIGN PRESSURES 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

Tab GmbH

Signature

Date

SP  
T.R.

REINFORCEMENT CALCULATION UG-37

REINFORCEMENT CALCULATION PER APPENDIX 1-7 DOES NOT APPLY

- (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.

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VIEW DATE: 7/2/85

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	B IN&OUT
DESIGN PRESSURE (P)	198. PSIG
HEADER SIZE (O.D.)	11.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.250 INCHES
INSIDE RADIUS (R)	5.250 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.092 INCHES
NOZZLE SIZE (O.D.)	4.500 INCHES
MATERIAL	SB-241-5083-0
ALLOWABLE STRESS (S)	10700. PSI
WALL THICKNESS (TN)	0.237 INCHES
INSIDE DIAMETER (D)	4.026 INCHES
INSIDE RADIUS (R)	2.013 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.038 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.237 INCHES
ACTUAL WELD LEG (W)	0.237 INCHES

REINFORCEMENT CALCULATION UG-37

AVAILABLE AREA	
SHELL: LARGER OF: (NOTE 1)	E1=1.00
A1A $D(E1*T-F*TR)-2*TN(E1*T-F*TR)(1-FR1)$	
A1B $2(T+TN)(E1*T-F*TR)-2*TN(E1*T-F*TR)(1-FR1)$	0.636 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 5(TN-TRN)(FR2)(TN)	0.222 IN2
ADDITIONAL AREA IF USED (RE-PAD OR INWARD NOZZLE)	
A3 $(DP-D-2TN)TE(FR4)$ OR $2(TN)FR2*H$	0.000 IN2
WELD AREA	
A4 $W*W*(FR2)$	0.053 IN2
ATOT $ATOT=A1+A2+A3+A4$	0.910 IN2
REQUIRED AREA	
$AREQ=D*TR*F+2*TN*TR*F(1-FR1)$ (F=1.0)	0.371 IN2

REINFORCEMENT CALCULATION PER APPENDIX 1-7 DOES NOT APPLY

- (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.

ZUL REINFORCEMENT CALCULATION  
DATE: 08-FEB-05  
DRAWING: 15771A REV A

MAR 23 2005

*T.R.*

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	C IN
DESIGN PRESSURE (P)	198. PSIG
HEADER SIZE (O.D.)	11.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.250 INCHES
INSIDE RADIUS (R)	5.250 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.092 INCHES
NOZZLE SIZE (O.D.)	6.625 INCHES
MATERIAL	SB-241-5083-0
ALLOWABLE STRESS (S)	10700. PSI
WALL THICKNESS (TN)	0.280 INCHES
INSIDE DIAMETER (D)	6.065 INCHES
INSIDE RADIUS (R)	3.033 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.057 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.250 INCHES
ACTUAL WELD LEG (W)	0.280 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 $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	0.957 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 $5(TN-TRN)(FR2)(TN)$	0.262 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 $W \cdot W \cdot (FR2)$	0.074 IN2
ATOT $ATOT = A1 + A2 + A3 + A4$	1.293 IN2
REQUIRED AREA	
$AREQ = D \cdot TR \cdot F + 2 \cdot TN \cdot TR \cdot F(1 - FR1) \quad (F=1.0)$	0.559 IN2

REINFORCEMENT CALCULATION APPENDIX (1-7a). (NOTE 2)  $R_n/R = 0.58$

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 $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	0.479 IN2
ATOT(1-7) = A1(1-7) + A2 + A3 + A4	0.814 IN2
$AREQ(1-7) = (2/3) \times AREQ$	0.373 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.

For Use Only  
By the Designer  
Original to be kept in the Project Files

72

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	C OUT
DESIGN PRESSURE (P)	198. PSIG
HEADER SIZE (O.D.)	13.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.250 INCHES
INSIDE RADIUS (R)	6.250 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.110 INCHES
NOZZLE SIZE (O.D.)	6.625 INCHES
MATERIAL	SB-241-5083-0
ALLOWABLE STRESS (S)	10700. PSI
WALL THICKNESS (TN)	0.280 INCHES
INSIDE DIAMETER (D)	6.065 INCHES
INSIDE RADIUS (R)	3.033 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.057 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.250 INCHES
ACTUAL WELD LEG (W)	0.280 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 $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	0.851 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 5(TN-TRN)(FR2)(TN)	0.262 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 $W \cdot W \cdot (FR2)$	0.074 IN2
ATOT $ATOT = A1 + A2 + A3 + A4$	1.186 IN2
REQUIRED AREA	
$AREQ = D \cdot TR \cdot F + 2 \cdot TN \cdot TR \cdot F(1 - FR1) \quad (F=1.0)$	0.665 IN2

REINFORCEMENT CALCULATION PER APPENDIX 1-7 DOES NOT APPLY

- (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 Genehmigung zugehörig.

PAR 2.2.2.2

T.R

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	D IN
DESIGN PRESSURE (P)	29. PSIG
HEADER SIZE (O.D.)	48.550 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.375 INCHES
INSIDE RADIUS (R)	23.900 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.061 INCHES
NOZZLE SIZE (O.D.)	16.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (TN)	0.250 INCHES
INSIDE DIAMETER (D)	15.500 INCHES
INSIDE RADIUS (R)	7.750 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.020 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG. =SMALLER OF (T), (TN) OR .25/.707	0.250 INCHES
ACTUAL WELD LEG (W)	0.250 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 $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	4.869 IN2
NOZZLE: SMALLER OF:	
5(TN - TRN)(FR2)(T) OR	
A2 5(TN - TRN)(FR2)(TN)	0.288 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 $W \cdot W \cdot (FR2)$	0.063 IN2
ATOT ATOT=A1+A2+A3+A4	5.219 IN2
REQUIRED AREA	
AREQ=D*TR*F+2*TN*TR*F(1-FR1) (F=1.0)	0.944 IN2

REINFORCEMENT CALCULATION PER APPENDIX 1-7 DOES NOT APPLY

- (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.

REINFORCED BY TIG WELDING  
DATE: 02-03-2005  
BY: [Signature]

02-03-2005

T.R.

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	D OUT
DESIGN PRESSURE (P)	29. PSIG
HEADER SIZE (O.D.)	48.550 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.375 INCHES
INSIDE RADIUS (R)	23.900 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.061 INCHES
NOZZLE SIZE (O.D.)	20.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (TN)	0.250 INCHES
INSIDE DIAMETER (D)	19.500 INCHES
INSIDE RADIUS (R)	9.750 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.025 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.250 INCHES
ACTUAL WELD LEG (W)	0.250 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 $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	6.125 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 5(TN-TRN)(FR2)(TN)	0.281 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 $W \cdot W \cdot (FR2)$	0.063 IN2
ATOT ATOT=A1+A2+A3+A4	6.469 IN2
REQUIRED AREA	
AREQ= $D \cdot TR \cdot F + 2 \cdot TN \cdot TR \cdot F(1 - FR1)$ (F=1.0)	1.187 IN2

REINFORCEMENT CALCULATION PER APPENDIX 1-7 DOES NOT APPLY

- (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.

FOR THE PURPOSES OF THIS CALCULATION  
THE FOLLOWING ASSUMPTIONS WERE MADE:  
1. THE NOZZLE IS WELDED TO THE HEADER BODY.  
2. THE NOZZLE IS WELDED TO THE HEADER BODY.  
3. THE NOZZLE IS WELDED TO THE HEADER BODY.

MAR 22 2005

T.R.



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	E IN	
DESIGN PRESSURE (P)	29. PSIG	
HEADER SIZE (O.D.)	48.550 INCHES	
MATERIAL	SB-209-5083-0	
ALLOWABLE STRESS (S)	11400. PSI	
WALL THICKNESS (T)	0.375 INCHES	
INSIDE RADIUS (R)	23.900 INCHES	
MINIMUM HEADER THICKNESS (UG-27)		
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.061 INCHES	
NOZZLE SIZE (O.D.)	20.000 INCHES	
MATERIAL	SB-209-5083-0	
ALLOWABLE STRESS (S)	11400. PSI	
WALL THICKNESS (TN)	0.250 INCHES	
INSIDE DIAMETER (D)	19.500 INCHES	
INSIDE RADIUS (R)	9.750 INCHES	
MINIMUM NOZZLE THICKNESS		
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.025 INCHES	
HEADER/NOZZLE WELD JOINT		
MIN. WELD LEG = SMALLER OF (T), (TN) OR .25/.707	0.250 INCHES	
ACTUAL WELD LEG (W)	0.250 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 $2(T + TN)(E1 \cdot T - F \cdot TR) - 2 \cdot TN(E1 \cdot T - F \cdot TR)(1 - FR1)$	6.125 IN2
NOZZLE: SMALLER OF:	
5(TN - TRN)(FR2)(T) OR	
A2 5(TN - TRN)(FR2)(TN)	0.281 IN2
ADDITIONAL AREA IF USED (RE-PAD OR INWARD NOZZLE)	
A3 (DP - D - 2TN)TE(FR4) OR 2(TN)FR2*H	0.000 IN2
WELD AREA	
A4 $W \cdot W \cdot (FR2)$	0.063 IN2
ATOT ATOT=A1+A2+A3+A4	6.469 IN2
REQUIRED AREA	
AREQ=D*TR*F+2*TN*TR*F(1-FR1) (F=1.0)	1.187 IN2

REINFORCEMENT CALCULATION PER APPENDIX 1-7 DOES NOT APPLY

- (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.

15771A-05 T.L.

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	E OUT
DESIGN PRESSURE (P)	29. PSIG
HEADER SIZE (O.D.)	48.550 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (T)	0.375 INCHES
INSIDE RADIUS (R)	23.900 INCHES
MINIMUM HEADER THICKNESS (UG-27)	
TR=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.061 INCHES
NOZZLE SIZE (O.D.)	24.000 INCHES
MATERIAL	SB-209-5083-0
ALLOWABLE STRESS (S)	11400. PSI
WALL THICKNESS (TN)	0.250 INCHES
INSIDE DIAMETER (D)	23.500 INCHES
INSIDE RADIUS (R)	11.750 INCHES
MINIMUM NOZZLE THICKNESS	
TRN=PR/(SE-.6P) (E=1.0 REFERENCE NOTE (4))	0.030 INCHES
HEADER/NOZZLE WELD JOINT	
MIN. WELD LEG =SMALLER OF (T), (TN) OR .25/.707	0.250 INCHES
ACTUAL WELD LEG (W)	0.250 INCHES

REINFORCEMENT CALCULATION UG-37

AVAILABLE AREA	
SHELL: LARGER OF: (NOTE 1)	E1=1.00
A1A D(E1*T-F*TR)-2*TN(E1*T-F*TR)(1-FR1)	
A1B 2(T+TN)(E1*T-F*TR)-2*TN(E1*T-F*TR)(1-FR1)	7.382 IN2
NOZZLE: SMALLER OF:	
5(TN-TRN)(FR2)(T) OR	
A2 5(TN-TRN)(FR2)(TN)	0.275 IN2
ADDITIONAL AREA IF USED (RE-PAD OR INWARD NOZZLE)	
A3 (DP-D-2TN)TE(FR4) OR 2(TN)FR2*H	0.000 IN2
WELD AREA	
A4 W*W*(FR2)	0.063 IN2
ATOT ATOT=A1+A2+A3+A4	7.719 IN2
REQUIRED AREA	
AREQ=D*TR*F+2*TN*TR*F(1-FR1) (F=1.0)	1.431 IN2

REINFORCEMENT CALCULATION APPENDIX (1-7a). (NOTE 2) Rn/R= 0.49

A1(1-7) = LARGER OF A1(1-7)A OR A1(1-7)B	
A1(1-7)A .5*D(E1*T-F*TR)-2*TN(E1*T-F*TR)(1-FR1)	
A1(1-7)B 2(T+TN)(E1*T-F*TR)-2*TN(E1*T-F*TR)(1-FR1)	3.691 IN2
ATOT(1-7)=A1(1-7)+A2+A3+A4	4.028 IN2
AREQ(1-7)=(2/3) X AREQ	0.954 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.

Page 9 of 18

T.R.

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 OR ARE CHECKED FOR COMPLIANCE WITH UG-45(b)(1).

A IN/OUT      HEADER 13.670 O.D. X 0.250 WALL X SB-209-5083-0      WITH BACKING STRIPS  
-----      NOZZLE 6.625 O.D. X 0.280 WALL X SB-241-5083-0      SEAMLESS  
              DESIGN PRESSURE = 198. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= 198. \text{ PSIG} \times 6.835 \text{ INCHES} = 0.181 \text{ INCHES} \\ &\text{-----} \\ &11400. \text{ PSI} \times 0.65 + .4 \times 198. \text{ PSIG} \end{aligned}$$

$$\text{MINIMUM HEADER THICKNESS} = 0.250 \text{ INCHES} - 0.018 \text{ INCH M.T.} = 0.232 \text{ INCHES}$$

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= 198. \text{ PSIG} \times 3.312 \text{ INCHES} = 0.061 \text{ INCHES} \\ &\text{-----} \\ &10700. \text{ PSI} \times 1.00 + .4 \times 198. \text{ PSIG} \end{aligned}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.280 \text{ INCHES} \times .875 = 0.245 \text{ INCHES}$$

B IN&OUT      HEADER 11.000 O.D. X 0.250 WALL X SB-209-5083-0      WITH BACKING STRIPS  
-----      NOZZLE 4.500 O.D. X 0.237 WALL X SB-241-5083-0      SEAMLESS  
              DESIGN PRESSURE = 198. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= 198. \text{ PSIG} \times 5.500 \text{ INCHES} = 0.145 \text{ INCHES} \\ &\text{-----} \\ &11400. \text{ PSI} \times 0.65 + .4 \times 198. \text{ PSIG} \end{aligned}$$

$$\text{MINIMUM HEADER THICKNESS} = 0.250 \text{ INCHES} - 0.018 \text{ INCH M.T.} = 0.232 \text{ INCHES}$$

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= 198. \text{ PSIG} \times 2.250 \text{ INCHES} = 0.041 \text{ INCHES} \\ &\text{-----} \\ &10700. \text{ PSI} \times 1.00 + .4 \times 198. \text{ PSIG} \end{aligned}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.237 \text{ INCHES} \times .875 = 0.207 \text{ INCHES}$$

C IN            HEADER 11.000 O.D. X 0.250 WALL X SB-209-5083-0      WITH BACKING STRIPS  
-----      NOZZLE 6.625 O.D. X 0.280 WALL X SB-241-5083-0      SEAMLESS  
              DESIGN PRESSURE = 198. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= 198. \text{ PSIG} \times 5.500 \text{ INCHES} = 0.145 \text{ INCHES} \\ &\text{-----} \\ &11400. \text{ PSI} \times 0.65 + .4 \times 198. \text{ PSIG} \end{aligned}$$

$$\text{MINIMUM HEADER THICKNESS} = 0.250 \text{ INCHES} - 0.018 \text{ INCH M.T.} = 0.232 \text{ INCHES}$$

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= 198. \text{ PSIG} \times 3.312 \text{ INCHES} = 0.061 \text{ INCHES} \\ &\text{-----} \\ &10700. \text{ PSI} \times 1.00 + .4 \times 198. \text{ PSIG} \end{aligned}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.280 \text{ INCHES} \times .875 = 0.245 \text{ INCHES}$$

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T.R

HEADER AND NOZZLE WALL THICKNESS CALCULATIONS PER APPENDIX 1, PAR. 1-1(a) (1)  
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NOTE: ALL NOZZLES ARE A MINIMUM OF STD WALL WHICH SATISFIES UG-45(b) REQUIREMENTS  
OR ARE CHECKED FOR COMPLIANCE WITH UG-45(b) (1).

C OUT        HEADER 13.000 O.D. X 0.250 WALL X SB-209-5083-0    WITH BACKING STRIPS  
-----        NOZZLE 6.625 O.D. X 0.280 WALL X SB-241-5083-0    SEAMLESS  
              DESIGN PRESSURE = 198. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= \frac{198. \text{ PSIG} \times 6.500 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 198. \text{ PSIG}} = 0.172 \text{ INCHES} \end{aligned}$$

$$\text{MINIMUM HEADER THICKNESS} = 0.250 \text{ INCHES} - 0.018 \text{ INCH M.T.} = 0.232 \text{ INCHES}$$

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{198. \text{ PSIG} \times 3.312 \text{ INCHES}}{10700. \text{ PSI} \times 1.00 + .4 \times 198. \text{ PSIG}} = 0.061 \text{ INCHES} \end{aligned}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.280 \text{ INCHES} \times .875 = 0.245 \text{ INCHES}$$

D IN        HEADER 48.550 O.D. X 0.375 WALL X SB-209-5083-0    WITH BACKING STRIPS  
-----        NOZZLE 16.000 O.D. X 0.250 WALL X SB-209-5083-0    TYPE (2) BUTT JOINT  
              DESIGN PRESSURE = 29. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= \frac{29. \text{ PSIG} \times 24.275 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 29. \text{ PSIG}} = 0.095 \text{ INCHES} \end{aligned}$$

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

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{29. \text{ PSIG} \times 8.000 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 29. \text{ PSIG}} = 0.031 \text{ INCHES} \end{aligned}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.250 \text{ INCHES} - 0.018 \text{ INCH M.T.} = 0.232 \text{ INCHES}$$

UG-45(b) (1) CHECK: 0.232 INCHES > 0.095 INCHES, UG-45(b) CRITERIA MET

D OUT        HEADER 48.550 O.D. X 0.375 WALL X SB-209-5083-0    WITH BACKING STRIPS  
-----        NOZZLE 20.000 O.D. X 0.250 WALL X SB-209-5083-0    TYPE (2) BUTT JOINT  
              DESIGN PRESSURE = 29. PSIG.

$$\begin{aligned} T \text{ REQ. (HEADER)} &= \frac{29. \text{ PSIG} \times 24.275 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 29. \text{ PSIG}} = 0.095 \text{ INCHES} \end{aligned}$$

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

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{29. \text{ PSIG} \times 10.000 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 29. \text{ PSIG}} = 0.039 \text{ INCHES} \end{aligned}$$

$$\text{MINIMUM NOZZLE THICKNESS} = 0.250 \text{ INCHES} - 0.018 \text{ INCH M.T.} = 0.232 \text{ INCHES}$$

UG-45(b) (1) CHECK: 0.232 INCHES > 0.095 INCHES, UG-45(b) CRITERIA MET

Zur Überprüfung des Zeichners

DATE:

BY: T.R.

HEADER AND NOZZLE WALL THICKNESS CALCULATIONS PER APPENDIX 1, PAR. 1-1(a) (1)  
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NOTE: ALL NOZZLES ARE A MINIMUM OF STD WALL WHICH SATISFIES UG-45(b) REQUIREMENTS  
OR ARE CHECKED FOR COMPLIANCE WITH UG-45(b) (1).

E IN NOZZLE 20.000 O.D. X 0.250 WALL X SB-209-5083-0 TYPE (2) BUTT JOINT  
----- DESIGN PRESSURE = 29. PSIG

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{29. \text{ PSIG} \times 10.000 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 29. \text{ PSIG}} = 0.039 \text{ INCHES} \end{aligned}$$

MINIMUM NOZZLE THICKNESS = 0.250 INCHES -0.018 INCH M.T. = 0.232 INCHES

UG-45(b) (1) CHECK: 0.232 INCHES > 0.095 INCHES, UG-45(b) CRITERIA MET

E OUT NOZZLE 24.000 O.D. X 0.250 WALL X SB-209-5083-0 TYPE (2) BUTT JOINT  
----- DESIGN PRESSURE = 29. PSIG

$$\begin{aligned} T \text{ REQ. (NOZZLE)} &= \frac{29. \text{ PSIG} \times 12.000 \text{ INCHES}}{11400. \text{ PSI} \times 0.65 + .4 \times 29. \text{ PSIG}} = 0.047 \text{ INCHES} \end{aligned}$$

MINIMUM NOZZLE THICKNESS = 0.250 INCHES -0.018 INCH M.T. = 0.232 INCHES

UG-45(b) (1) CHECK: 0.232 INCHES > 0.095 INCHES, UG-45(b) CRITERIA MET

Das Dokument ist dem Herrn zugehörig.

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Das Dokument ist dem Herrn zugehörig.

12

MINIMUM ASME THICKNESS REQUIREMENTS FOR ALUMINUM FLATENDS:

FLATEND DESIGN FOR A IN/OUT HEADER 13.670 INCH O.D. BY 0.250 INCH WALL

TWO SETS OF CRITERIA MUST BE MET WHEN ATTACHING UNSTAYED FLATENDS TO HEADERS.

THE FIRST IS FOUND IN SECTION VIII, PARA. UG-34(C)(3)  
WHICH YIELDS THE FORMULA:

$$T = d \cdot \text{SQURE ROOT OF}(ZCP/SE)$$

WHERE:

d = SHORT SPAN OF A FLAT HEAD (THE RADIUS) = 6.585 INCHES  
D = LONG SPAN OF A FLAT HEAD (THE DIAMETER) = 13.170 INCHES  
C = HEAD ATTACHMENT FACTOR WHICH = .33m PER FIGURE UG-34(E)  
m = tr/ts BUT CONSERVATIVELY SET AT 1.0 THUS C = .33  
E = JOINT EFFICIENCY FOR CATEGORY A WELDS; THE PLATE IS  
SEAMLESS SO E = 1.0  
P = DESIGN PRESSURE = 198. PSIG  
S = MAXIMUM ALLOWABLE ASME STRESS VALUE (PSI)

FOR SB-209-5083-0 ALUMINUM S = 11400. PSI

$$Z = 3.4 - (2.4 \cdot d/D)$$

$$\text{HENCE } Z = 3.4 - (2.4 \cdot 6.585/13.170) = 2.20$$

THEREFORE, TMIN, BASED ON THE ABOVE CRITERIA IS:

$$T_{\text{MIN}} = d \cdot \text{SQURE ROOT OF}(Z \cdot .33 \cdot P/SE) = 0.739 \text{ INCHES}$$

THE SECOND CRITERIA IS BASED ON FIGURE UG-34(E) WHICH SPECIFIES THE  
FLATEND MUST EXTEND BEYOND THE HEADER BY A DISTANCE NO LESS THAN THE  
THICKNESS OF THE SHELL (TS). DESIGN PRACTICE IS TO SELECT A NOMINAL  
PLATE THICKNESS OF AT LEAST (TS+.125 IN) TO ALLOW SOME INSERTION OF THE  
FLATEND INTO THE HEADER BODY.

THEREFORE THE MINIMUM NOMINAL PLATE THICKNESS IS:

$$T(\text{SHELL}) + 0.125 = 0.375 \text{ INCHES}$$

THE MINIMUM FLATEND THICKNESS 0.945 IN. (1.000 IN NOM.- 0.055 IN M.T.)  
MEETS OR EXCEEDS TMIN THEREFORE THE DESIGN MEETS THE MINIMUM REQUIREMENTS  
OF THE ASME CODE.

THE DESIGNER HAS REVIEWED THE  
DESIGN AND APPROVES THE  
DESIGN.

72

MINIMUM ASME THICKNESS REQUIREMENTS FOR ALUMINUM FLATENDS:

FLATEND DESIGN FOR B IN&OUT HEADER 11.000 INCH O.D. BY 0.250 INCH WALL

TWO SETS OF CRITERIA MUST BE MET WHEN ATTACHING UNSTAYED FLATENDS TO HEADERS.

THE FIRST IS FOUND IN SECTION VIII, PARA. UG-34(C)(3)  
WHICH YIELDS THE FORMULA:

$$T = d \cdot \text{SQURE ROOT OF}(ZCP/SE)$$

WHERE:

d = SHORT SPAN OF A FLAT HEAD (THE RADIUS) = 5.250 INCHES  
D = LONG SPAN OF A FLAT HEAD (THE DIAMETER) =10.500 INCHES  
C = HEAD ATTACHMENT FACTOR WHICH = .33m PER FIGURE UG-34(E)  
m = tr/ts BUT CONSERVATIVELY SET AT 1.0 THUS C = .33  
E = JOINT EFFICIENCY FOR CATEGORY A WELDS; THE PLATE IS  
SEAMLESS SO E = 1.0  
P = DESIGN PRESSURE = 198. PSIG  
S = MAXIMUM ALLOWABLE ASME STRESS VALUE (PSI)

FOR SB-209-5083-0 ALUMINUM S = 11400. PSI

$$Z=3.4-(2.4*d/D).$$

$$\text{HENCE } Z=3.4-(2.4* 5.250/10.500)= 2.20$$

THEREFORE, TMIN, BASED ON THE ABOVE CRITERIA IS:

$$TMIN = d \cdot \text{SQURE ROOT OF}(Z \cdot .33 \cdot P/SE) = 0.590 \text{ INCHES}$$

THE SECOND CRITERIA IS BASED ON FIGURE UG-34(E) WHICH SPECIFIES THE FLATEND MUST EXTEND BEYOND THE HEADER BY A DISTANCE NO LESS THAN THE THICKNESS OF THE SHELL (TS). DESIGN PRACTICE IS TO SELECT A NOMINAL PLATE THICKNESS OF AT LEAST (TS+.125 IN) TO ALLOW SOME INSERTION OF THE FLATEND INTO THE HEADER BODY.

THEREFORE THE MINIMUM NOMINAL PLATE THICKNESS IS:

$$T(\text{SHELL})+0.125 = 0.375 \text{ INCHES}$$

THE MIMIMUM FLATEND THICKNESS 0.593 IN. (0.625 IN NOM.- 0.032 IN M.T.)  
MEETS OR EXCEEDS TMIN THEREFORE THE DESIGN MEETS THE MINIMUM REQUIREMENTS  
OF THE ASME CODE.

For Approval/Review/Signature  
Date: \_\_\_\_\_  
By: \_\_\_\_\_

11/11/05 T.R

MINIMUM ASME THICKNESS REQUIREMENTS FOR ALUMINUM FLATENDS:

FLATEND DESIGN FOR C IN      HEADER    11.000 INCH O.D. BY 0.250 INCH WALL

TWO SETS OF CRITERIA MUST BE MET WHEN ATTACHING UNSTAYED FLATENDS TO HEADERS.

THE FIRST IS FOUND IN SECTION VIII, PARA. UG-34 (C) (3)  
WHICH YIELDS THE FORMULA:

$$T = d * \text{SQUARE ROOT OF } (ZCP/SE)$$

WHERE:

D = SHORT SPAN OF A FLAT HEAD (THE RADIUS) = 5.250 INCHES  
D = LONG SPAN OF A FLAT HEAD (THE DIAMETER) = 10.500 INCHES  
C = HEAD ATTACHMENT FACTOR WHICH = .33m PER FIGURE UG-34 (E)  
m = tr/ts BUT CONSERVATIVELY SET AT 1.0 THUS C = .33  
E = JOINT EFFICIENCY FOR CATEGORY A WELDS; THE PLATE IS  
SEAMLESS SO E = 1.0  
P = DESIGN PRESSURE = 198. PSIG  
S = MAXIMUM ALLOWABLE ASME STRESS VALUE (PSI)

FOR SB-209-5083-0 ALUMINUM S = 11400. PSI

$$Z=3.4-(2.4*d/D) .$$

HENCE  $Z = 3.4 - (2.4 * 5.250 / 10.500) = 2.20$

THEREFORE, TMIN, BASED ON THE ABOVE CRITERIA IS:

$$TMIN = d * \text{SQUARE ROOT OF}(Z * .33 * P / SE) = 0.590 \text{ INCHES}$$

THE SECOND CRITERIA IS BASED ON FIGURE UG-34(E) WHICH SPECIFIES THE FLATEND MUST EXTEND BEYOND THE HEADER BY A DISTANCE NO LESS THAN THE THICKNESS OF THE SHELL (TS). DESIGN PRACTICE IS TO SELECT A NOMINAL PLATE THICKNESS OF AT LEAST (TS+.125 IN) TO ALLOW SOME INSERTION OF THE FLATEND INTO THE HEADER BODY.

THEREFORE THE MINIMUM NOMINAL PLATE THICKNESS IS:

$$T(\text{SHELL}) + 0.125 = 0.375 \text{ INCHES}$$

THE MINIMUM FLATEND THICKNESS 0.593 IN. (0.625 IN NOM.- 0.032 IN M.T.)  
MEETS OR EXCEEDS TMIN THEREFORE THE DESIGN MEETS THE MINIMUM REQUIREMENTS  
OF THE ASME CODE.

Zur Bewertung notwendig zugehörig.  
Bewertung des Sachverständigen.  
Prüfungstermin / Review date:

15

T.L.



MINIMUM ASME THICKNESS REQUIREMENTS FOR ALUMINUM FLATENDS:

FLATEND DESIGN FOR C OUT      HEADER    13.000 INCH O.D. BY 0.250 INCH WALL

TWO SETS OF CRITERIA MUST BE MET WHEN ATTACHING UNSTAYED FLATENDS TO HEADERS.

THE FIRST IS FOUND IN SECTION VIII, PARA. UG-34(C)(3)  
WHICH YIELDS THE FORMULA:

$$T = d \cdot \text{SQARE ROOT OF}(ZCP/SE)$$

WHERE:

d = SHORT SPAN OF A FLAT HEAD (THE RADIUS) = 6.250 INCHES  
D = LONG SPAN OF A FLAT HEAD (THE DIAMETER) =12.500 INCHES  
C = HEAD ATTACHMENT FACTOR WHICH = .33m PER FIGURE UG-34(E)  
m = tr/ts BUT CONSERVATIVELY SET AT 1.0 THUS C = .33  
E = JOINT EFFICIENCY FOR CATEGORY A WELDS; THE PLATE IS  
SEAMLESS SO E = 1.0  
P = DESIGN PRESSURE = 198. PSIG  
S = MAXIMUM ALLOWABLE ASME STRESS VALUE (PSI)

FOR SB-209-5083-0    ALUMINUM S = 11400. PSI

$$Z=3.4-(2.4*d/D).$$

$$\text{HENCE } Z=3.4-(2.4* 6.250/12.500)= 2.20$$

THEREFORE, TMIN, BASED ON THE ABOVE CRITERIA IS:

$$TMIN = d \cdot \text{SQARE ROOT OF}(Z*.33*P/SE) = 0.702 \text{ INCHES}$$

THE SECOND CRITERIA IS BASED ON FIGURE UG-34(E) WHICH SPECIFIES THE  
FLATEND MUST EXTEND BEYOND THE HEADER BY A DISTANCE NO LESS THAN THE  
THICKNESS OF THE SHELL (TS). DESIGN PRACTICE IS TO SELECT A NOMINAL  
PLATE THICKNESS OF AT LEAST (TS+.125 IN) TO ALLOW SOME INSERTION OF THE  
FLATEND INTO THE HEADER BODY.

THEREFORE THE MINIMUM NOMINAL PLATE THICKNESS IS:

$$T(\text{SHELL})+0.125 = 0.375 \text{ INCHES}$$

THE MIMIMUM FLATEND THICKNESS 0.707 IN. (0.750 IN NOM.- 0.043 IN M.T.)  
MEETS OR EXCEEDS TMIN THEREFORE THE DESIGN MEETS THE MINIMUM REQUIREMENTS  
OF THE ASME CODE.

DESIGNED BY: [Signature]  
CHECKED BY: [Signature]  
DATE: [Signature]  
REVIEW DATE: [Signature]

WAP 22 2005 T.R

MINIMUM ASME THICKNESS REQUIREMENTS FOR ALUMINUM FLATENDS:

FLATEND DESIGN FOR D/E IN&OUT HEADERS 48.550 INCH O.D. BY 0.375 INCH WALL

TWO SETS OF CRITERIA MUST BE MET WHEN ATTACHING UNSTAYED FLATENDS TO HEADERS.

THE FIRST IS FOUND IN SECTION VIII, PARA. UG-34(C) (3)  
WHICH YIELDS THE FORMULA:

$$T = d \cdot \text{SQUARE ROOT OF } (ZCP/SE)$$

WHERE:

d = SHORT SPAN OF A FLAT HEAD = 19.340 INCHES  
D = LONG SPAN OF A FLAT HEAD = 46.922 INCHES  
C = HEAD ATTACHMENT FACTOR WHICH = .33m PER FIGURE UG-34(E)  
m = tr/ts BUT CONSERVATIVELY SET AT 1.0 THUS C = .33  
E = JOINT EFFICIENCY FOR CATEGORY A WELDS; THE PLATE IS  
SEAMLESS SO E = 1.0  
P = DESIGN PRESSURE = 29. PSIG  
S = MAXIMUM ALLOWABLE ASME STRESS VALUE (PSI)

FOR SB-209-5083-0 ALUMINUM S = 11400. PSI

$$Z = 3.4 - (2.4 \cdot d/D).$$

$$\text{HENCE } Z = 3.4 - (2.4 \cdot 19.340/46.922) = 2.41$$

THEREFORE, TMIN, BASED ON THE ABOVE CRITERIA IS:

$$T_{\text{MIN}} = d \cdot \text{SQUARE ROOT OF } (Z \cdot .33 \cdot P/SE) = 0.870 \text{ INCHES}$$

THE SECOND CRITERIA IS BASED ON FIGURE UG-34(E) WHICH SPECIFIES THE  
FLATEND MUST EXTEND BEYOND THE HEADER BY A DISTANCE NO LESS THAN THE  
THICKNESS OF THE SHELL (TS). DESIGN PRACTICE IS TO SELECT A NOMINAL  
PLATE THICKNESS OF AT LEAST (TS+.125 IN) TO ALLOW SOME INSERTION OF THE  
FLATEND INTO THE HEADER BODY.

THEREFORE THE MINIMUM NOMINAL PLATE THICKNESS IS:

$$T(\text{SHELL}) + 0.125 = 0.500 \text{ INCHES}$$

THE MINIMUM FLATEND THICKNESS 0.945 IN. (1.000 IN NOM.- 0.055 IN M.T.)  
MEETS OR EXCEEDS TMIN THEREFORE THE DESIGN MEETS THE MINIMUM REQUIREMENTS  
OF THE ASME CODE.

FOR INFORMATION OF THE ENGINEER  
THE DESIGN MEETS THE MINIMUM REQUIREMENTS  
OF THE ASME CODE.

T.R.

MINIMUM ASME THICKNESS REQUIREMENTS FOR ALUMINUM FLATENDS:

SPLITTER PLATE DESIGN FOR HEADER(S) D/E IN&OUT

HEADER SIZE 48.550 INCH O.D. BY 0.375 INCH WALL  
INSIDE DIAMETER = 47.80 INCHES  
INSIDE RADIUS = 23.90 INCHES

SPLITTER WIDTH = 46.92 INCHES  
SPLITTER HEIGHT = 19.34 INCHES

PER UG-34 (C) (3):

$$T \text{ REQUIRED} = D \cdot \text{SQUARE ROOT OF } (ZCP/SE)$$

WHERE:

D = SHORT SPAN OF A FLAT HEAD = 19.34 INCHES  
DD = LONG SPAN OF A FLAT HEAD = 46.92 INCHES  
C = HEAD ATTACHMENT FACTOR WHICH = .33 PER FIGURE UG-34 (E)  
E = JOINT EFFICIENCY FOR CATEGORY A WELDS (THE PLATE IS SEAMLESS SO E = 1.0)  
P = DESIGN PRESSURE = 29. PSIG  
S = MAXIMUM ALLOWABLE ASME STRESS VALUE (PSI)  
FOR SB-209-5083 ALUMINUM, S = 11400. PSI

$$Z = 3.4 - 2.4(D/DD) \quad [\text{MAXIMUM OF } 2.5]$$
$$Z = 3.4 - 2.4(19.34/46.92) = 2.41$$

$$T \text{ REQ} = D \cdot \text{SQUARE ROOT OF } (Z \cdot .33 \cdot P/SE)$$
$$T \text{ REQ} = 19.34 \cdot \text{SQUARE ROOT OF } (2.41 \cdot .33 \cdot 29. / 11400. \cdot 1.0)$$
$$T \text{ REQ} = 0.870 \text{ INCHES}$$

THE MINIMUM THICKNESS 0.945 IN. (1.000 IN NOM.- 0.055 IN M.T.)  
MEETS OR EXCEEDS TREQ THEREFORE THE DESIGN MEETS THE MINIMUM  
REQUIREMENTS OF THE ASME CODE.

WELD STRENGTH FOR SPLITTER PLATE TO CORE ATTACHMENT:

DESIGN PRESSURE = 29. PSIG  
SPLITTER PLATE HEIGHT = 19.34 INCHES

$$\text{LOAD ON WELD} = 29. \text{ PSIG} \cdot 19.34 \text{ INCHES} / 2 = 280. \text{ LBS/INCH}$$

GROOVE WELD SIZE = 0.750 INCHES

$$\text{ASME ALLOWABLE LOAD} = 0.750 \text{ INCHES} \cdot (.55 \cdot 3400. \text{ PSI}) = 1402. \text{ LBS/INCH}$$

NOTE .55 WAS USED SINCE FAILURE MODE IS SHEAR AS IS TYPICAL  
FOR A FILLET WELD.

SINCE 1402. LBS/INCH > 280. LBS/INCH, THE WELD IS ADEQUATE.

DESIGNED BY: [Signature]  
CHECKED BY: [Signature]  
APPROVED BY: [Signature]

T. E.

Subject: Supplemental ASME submittal calculations per the 2001 Edition, 2003 Addenda of Section VIII, Division 1.

Customer: AL-DEUTSCHLAND (MESSER)  
Sales Order: 509.9  
Assembly drawing: 15771A REV A  
ITEM: W23001

Maximum design temperature 150. F

Test pressure calculation:  
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Stream	Test Method	CUSTOMER SPECIFIED DESIGN PRESSURE PSIG		CORRECTION Factor		EQUIVALENT DESIGN PSIG		TEST FACTOR		S test/S design		Test Pressure PSIG
A	PNEU	145.	X	1.50/1.1	=	198.	X	1.10	X	1.000	=	218.
B	PNEU	145.	X	1.50/1.1	=	198.	X	1.10	X	1.000	=	218.
C	PNEU	145.	X	1.50/1.1	=	198.	X	1.10	X	1.000	=	218.

NOTE: CUSTOMER MANDATED PNEU TEST PRESSURE OF 1.50 TIMES THEIR SPECIFIED DESIGN PRESSURE. CALCULATIONS WERE BASED ON AN EQUIVALENT DESIGN PRESSURE TO CORRECT FOR THE ELEVATED PNEUMATIC TEST PRESSURES.

Stream	Test Method	Test Factor		MAWP PSIG		S test/S design		Test Pressure PSIG
D	PNEU	1.10	X	29. X		1.000	=	32.
E	PNEU	1.10	X	29. X		1.000	=	32.

Calculations for Core block components:  
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Parting sheet calculations:  
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The parting sheet thickness is selected to carry the outward pressure force on the bar columns of the exchanger. The required thickness is a function of the layer heights and pressures. The calculation method is outlined as follows.

Equation:

$$t_{\text{required}} = \frac{\text{outward pressure}}{\# \text{ of layers} \times S_a}$$

Where:  $S_a$  is the allowable parting sheet stress.

Outward pressure = sum of the product of the layer heights x layer pressure.

2005 FEB 08 10:00 AM  
15771A  
MESSER

T.R.

Section 1 :

Stream A	42. layers, 0.250" high at	198. psig =	2079. lb/in
Stream D	84. layers, 0.380" high at	29. psig =	926. lb/in
sum	126. layers		3005. lb/in

$$\text{min sheet} = \frac{3005. \text{ lb/in}}{126. * 3400. \text{ psi}} = 0.007 \text{ in} < 0.039 \text{ in}$$

Section 2 :

Stream B	14. layers, 0.250" high at	198. psig =	693. lb/in
Stream C	28. layers, 0.250" high at	198. psig =	1386. lb/in
Stream E	84. layers, 0.380" high at	29. psig =	926. lb/in
sum	126. layers		3005. lb/in

$$\text{min sheet} = \frac{3005. \text{ lb/in}}{126. * 3400. \text{ psi}} = 0.007 \text{ in} < 0.039 \text{ in}$$

APPROVED FOR CONSTRUCTION  
DATE: 02/08/05  
BY: [Signature]

WAR 23 2005

[Signature]