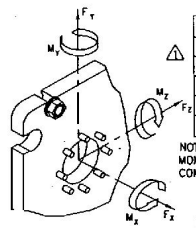
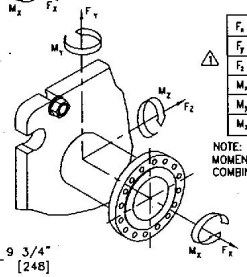
MATERIALS OF CONSTRUCTION

ITEM NO.	DESCRIPTION	MATERIAL
1	HEAD	SA516 GR70
2	FOLLOWER	SA516 GR70
3	END SUPPORT	A36
4	TOP BAR	A36 W/304 SS STRIP
5	BOTTOM BAR	A36 W/304 SS COVER
6	M48 DIA. TIE BAR	SA193 GR87
7	TIE BAR HEX NUTS	SA194 GR2H ZINC PLATED
8	HEAT TRANSFER PLATES	SA240 GR316
9	STUDS	SA193 GR87 ZINC PLATED
10	LINERS	316L STAINLESS STEEL
11	PIPE	SA312 GRTP316L
12	RINGS	SA240 TYPE 316L
13	STUB ENDS	SA316 GRTP316L
14	FLANGES	SA105
15	GROUNDING LUGS	A36



F_x (KN)	19.525
F_y (KN)	14.8
F_z (KN)	11.734
M_x (KNm)	15.375
M_y (KNm)	29.025
M_z (KNm)	27.625

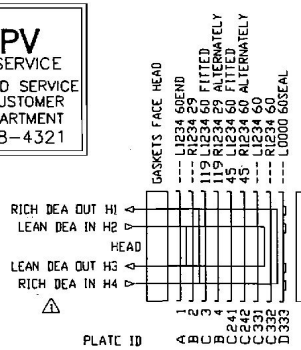
NOTE:
MOMENTS AND FORCES MAY ACT IN ANY COMBINATION IN ANY SENSE (ie. +/-).



F_x (KN)	19.525
F_y (KN)	14.8
F_z (KN)	11.734
M_x (KNm)	15.375
M_y (KNm)	29.4
M_z (KNm)	27.625

NOTE:
MOMENTS AND FORCES MAY ACT IN ANY COMBINATION IN ANY SENSE (ie. +/-).

APV
FACTORY SERVICE
FOR PARTS AND SERVICE
CALL OUR CUSTOMER
SERVICE DEPARTMENT
1-888-278-4321



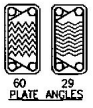
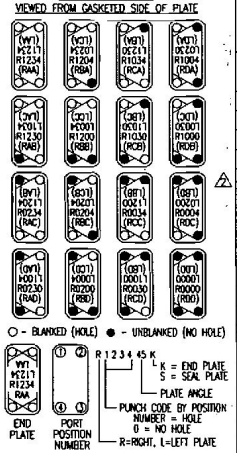


PLATE IDENTIFICATION
VIEWED FROM GASKETED SIDE OF PLATE



○ - BLANKED (HOLE) ● - UNBLANKED (NO HOLE)

DESIGN SPECIFICATIONS

DESIGN CODES	ASME SECTION VIII DIV 1, 2004 EDITION API 662 SOUND ENGINEERING PRACTICE
Manufactured in accordance with Sound Engineering Practice per Article 3 paragraph 3 of Pressure Equipment Directive 97/23/EC	
MAX. ALLOWABLE WORKING PRESSURE	248 PSIG. (1710 kPa) FV
MINIMUM DESIGN METAL TEMPERATURE	-20 °F. @ 248 PSIG. (-29°C @ 1710 kPa)
HYDROTEST PRESSURE	322 PSIG. (2223 kPa) FV
MINIMUM OPERATING TEMPERATURE	-20°F (29°C)
MAXIMUM OPERATING TEMPERATURE	347°F (175°C) (SEE NOTE 8)
HEAT TRANSFER AREA	4774.2 SQ.FT. (443.5 SQ.M.)
FRAME SIZE	No. 30
FRAME CAPACITY	455 PLATES MAX.
DRY WEIGHT	15251 LBS. (6918 KG)
FLOODED (OPERATING) WEIGHT	18509 LBS. (8396 KG)
TOTAL LIQUID VOLUME	391.2 GALS. (1480.7 LITERS)
FINISH	APV STANDARD PAINT 3196
ACCESSORIES	304 SS SHROUD
	GROUNDING LUGS

OPERATING CONDITIONS

LIQUID	FLOW RATE	TEMP. °C	ΔP (kPa)
LEAN DEA	216.66 KG/S	128.4° → 76.6°	35.0
RICH DEA	226.21 KG/S	53.3° → 104.4°	37.0

Plates (Total: 333)

ID	Qty	Port Number	Description
A	1	6046K4XAX6AZZXA	P&G ASY B134S (60) END 316 0.6 PCL EPDM (1 GREY)
B	120	6042F4XAX6AZZXA	P&G ASY B134S (29) FLOW 316 0.6 PCL EPDM (1 GREY)
C	211	6046F4XAX6AZZXA	P&G ASY B134S (60) FLOW 316 0.6 PCL EPDM (1 GREY)
D	1	6046YOXAX6AZZXA	P&G ASY B134S (60) SEAL 316 0.6 PCL EPDM (1 GREY)

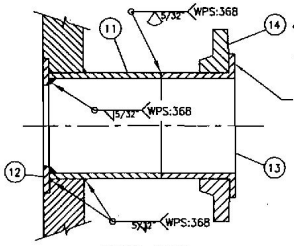
Frame

Qty	Part Number	Description
1	B134XXC20XXX30B	B134 M-20c (C:SS T:CS) Size 30, Max 455 Plates
1	GB506586G2WXWXG2	Head
1	GB506587AXAXAXAX	Follower

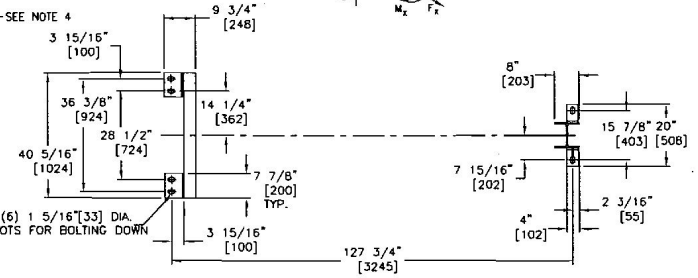
Fitting

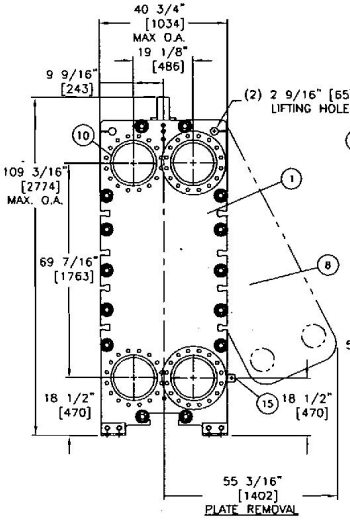
Qty	Part Number	Position	Description
2	120HGEPR95A	H1,H4	NPS 12 Studded SS 316L ANSI B16.5 CL300
2	GB506700	H2,H3	NPS 12 LJF SS 316L ANSI B16.5 CL300

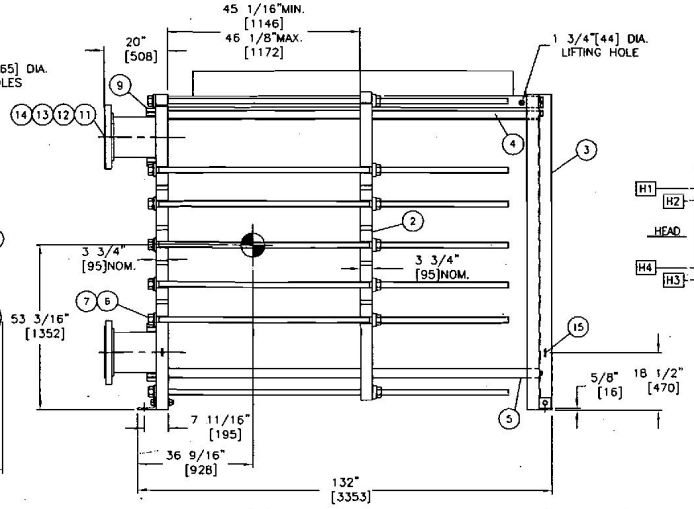
Qty	Part Number	Accessory Description
1	500700	SS Shroud, FS3
1	ASME U STAMP	ASME INSPECTION AND U STAMP AND NAT'L BOARD No.
1	501255	GROUNDING LUG HEAD
1	501252	GROUNDING LUG END SUPPORT

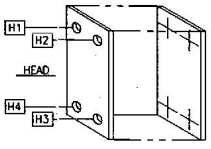


WELD MAP
LAP JOINT FLANGE





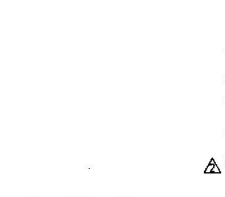




UNPORTED FOLLOWER

NOTES

1. THE INSTALLATION, OPERATION AND MAINTENANCE OF THIS HEAT EXCHANGER SHALL BE IN ACCORDANCE WITH THE APV PARAFLOW PLATE HEAT EXCHANGER INSTRUCTION MANUAL.
2. THIS MODEL HEAT EXCHANGER IS TIGHTENED USING A WRENCH ON THE TIE BAR HEX NUTS AT THE HEAD (FIXED COVER) END ONLY. CLEAN AND LUBRICATE THE THREADS BEFORE OPENING OR CLOSING USING A LUBRICANT COMPATIBLE WITH CARBON STEEL. APV RECOMMENDS NEVER-SEEZ REGULAR GRADE. DO NOT USE COMMON GREASE.
   THE PLATE PACK IS TO BE TIGHTENED IN ACCORDANCE WITH THE INSTRUCTION MANUAL SUPPLIED. DO NOT TIGHTEN BELOW THE MINIMUM DIMENSION SHOWN.
3. THE CUSTOMER IS RESPONSIBLE FOR PROVIDING:
   - ANCHOR BOLTS PER ASTM A36 MINIMUM WITH A RECOMMENDED DIAMETER OF 1 3/16".
   - PROTECTION AGAINST START UP OR OPERATING PRESSURES EXCEEDING THE MAXIMUM ALLOWABLE WORKING PRESSURE.
   - PIPING TO THE FOLLOWER OR CONNECTOR GRIDS THAT ALLOWS FOR FREE MOVEMENT WHEN THE UNIT IS OPENED FOR SERVICE AND PROVIDES FLEXIBILITY FOR THE VARIATION OF THE COMPRESSED PLATAGE DIMENSIONS.
4. NOZZLES ARE PROVIDED WITH A SMOOTH RAISED FACE FINISH. LINED STUDDED PORTS ARE PROVIDED WITH A SMOOTH RAISED FACE FINISH.
5. BOLT HOLES STRADDLE CENTERLINES SHOWN.
6. DIMENSIONS ARE SHOWN IN INCHES. DIMENSIONS IN BRACKETS [ ] ARE IN MILLIMETERS.
7. STANDARD TOLERANCES:
   FRAME AND FOUNDATION BOLT LOCATIONS: ±1/4 INCH [±6mm]
⚠ 8. LONG TERM OPERATION AT THIS TEMPERATURE IS NOT RECOMENDED IT WILL SIGNIFICATELY REDUCE LIFE OF GASKETS.



PROJECT NO. 103933
CONTRACT NO. 383-1086
CUSTOMER NO. 0032
REV. 3
TAG NO. 52-E-3A
Kiewit APEG

05	KWR 7-11-06		CORRECTED FLANGE MAT'L
04	KWR 1-23-06		ADDED CRN
03	KWR 1-23-06		INCORPORATED COMMENTS - AREA
02	KWR 12-12-05		INCORPORATED CUSTOMER/AREA COMMENTS/REQUIREMENTS
01	KWR 9-28-05	GAL 9-28-05	APPROVED - INCORPORATED COMMENTS
REV.	BY / DATE	CK. BY / DATE	DESCRIPTION AND LOCATION

invensys APV
APV Products
1200 W. Ash Street
Goldsboro, NC 27530
Tel: (919) 735-4570/Fax: (919) 581-1134

Description: B134 MGS-20 PLATE HEAT EXCHANGER
Checked: Date: Superseder:
Approved: Date:
Drawn: KWR Date: 8-8-05
Scale: N.T.S. Sheet: 1 OF 1
Drawing No.: 0500602 Rev.: 05
CAD File: 0500602 A
AUTOCAD REL. 2005

Plate and Frame Exchanger

DATA SHEET NO.	REV.
52-E-3-DS-1	1

NO.	BY	DATE	REVISION
0	GQW	31-Jul-05	ISSUED FOR PURCHASE
1	GQW	17-Apr-06	AS BUILT

SHEET	OF	DATE	
1	2	17-Apr-06	
BY	CHK'D	PROC.	APPR.
GQW			

P.O.: 1 383-1296-0032
REQ.: HT-1300-005

TAG NO.: 52-E-3A/B/C
Spec No:
Asset No:
P&ID: 52-PID-PR-0007
Service Description: Lean/ Rich Exchanger
Manufacturer: APV
Model: B134
User 1:
User 2:
User 3:
User 4:

rev

General

Job No.:	103933		Process Unit:	52 Amine Unit			
Item No.:	52-E-3A/B/C		Fabricator:	APV			
Location:	Fort McMurray		No. of Units	Two (1 operating & 1 spare) (Note 9.) 1			
Size	M-20 Ser. 2/3 mm Type		No. Connected in	1	Parallel	1	Series
Surface area/Unit (Eff.)	443.5	m²	Shells/Unit	1	Surface area/Shell (Eff.)	443.5	m²

Performance of One Unit

Fluid Allocation:	HOT SIDE		COLD SIDE	
Fluid Name:	Lean DEA		Rich DEA	
Fluid Quantity, Total: kg/hr	779,963		814,366	
	IN	OUT	IN	OUT
Fluid Quantity, Vapor (In/Out): kg/hr				
Fluid Quantity, Liquid: kg/hr	779,963	779,963		
Fluid Quantity, Steam: kg/hr				
Fluid Quantity, Water: kg/hr			814,366	814,366
Fluid Quantity, Noncondensable (MW): kg/hr				
Temperature (In/Out): °C	128.4	76.6	53.3	104.4
Density (Vapor/Liquid): kg/m3	958	999	1031.9	991
Viscosity (Vapor/Liquid): mPa-s	0.352	0.800	1.194	0.457
Molecular Weight, Vapor				
Specific Heat (Vapor/Liquid): kJ/(kg*°C)	3.904	3.791	3.689	3.783
Thermal Conductivity (Vapor/Liquid): W/(m*°C)	0.485	0.475	0.441	0.453
Dew Point °C				
Bubble Point °C				
Critical Pressure kPa(g)				
Critical Temperature °C				
Latent Heat: KJ/kg@*°C				
Surface Tension Dyne/cm	44.87	53.48	58.00	47.47
Inlet Pressure: kPa(g)	250		793	
Velocity: m/s	1 3.1 (port), 0.49 (passages)		1 3.1 (Port), 0.50 (passages)	
Pressure Drop (Allowable/Calculated): kPa	35	35	70	37
Overall Fouling Allowance: % Excess Area	10		10	
Wall Shear Stress kPa	29		30	
Heat Exchanged per Unit: 43,194,440 Watts	LMTD (Corrected) (Weighted): 1 23.63 °C			
Transfer Rate (Service/Clean): 1 4,121	4,535			W/(m²*°C)

Notes

Remarks: * Information to be supplied by Manufacturer

1. Design case: Napthenic Solvent design case flow, composition and conditions.
2. Nozzles shall be designed for the loads shown in Attachment 1, Nozzle Loads for Plate & Frame Heat Exchangers, Rev. 0.
3. Insulation - 50 mm Hot (by others).
4. All materials and components in contact with process fluid to meet 00-STD-ME-0034 requirement, Category 1.
5. CRN/ ABSA registration required.
6. Structural design shall be per 00-STD-ST-0001, Rev. 4. Saddles shall be designed for -45 °C minimum ambient temperature.
7. Provide loads (weight and forces) at the bottoms of the base plates.
8. Nozzles (if provided) shall have sufficient projection to permit removal of flange bolts without disturbing insulation.
9. Two units are required, the above data is for one unit. Units 52-E-3A/B will be installed initially in Phase 1 (one operating and one spare). 52-E-3C will be installed in the future in Phase 2.
10. The exchanger design shall prevent process fluids from contacting carbon steel surfaces.
11. Structural supports shall have 1.6 mm corrosion allowance.

TAG NO.	52-E-3A/B/C	Plate and Frame Exchanger	DATA SHEET NO.	REV.	SHT	OF
			52-E-3-DS-1	1	2	2

			HOT SIDE		COLD SIDE	
Design Press / Test Press.		kPa(g)	1,710 & FV / per code		1,710 & FV / per code	
Design / MDMT Temperature:		°C	175 / -29		175 / -29	
Corrosion Allowance (wetted Carbon Steel only):		mm	(Note 10)		(Note 10)	
No.of Passes / No. Channels per pass:			1 / 166		1 / 166	
Passages Per Pass						
Number of Plates per Frame	333		455 (Max.)	Plate Thickness	0.6	mm
Connections Size, Rating & Type:	In:		12" 300# RF		12" 300# RF	Type: Studded Port (Hot), Flange (Cold)
	Out:		12" 300# RF		12" 300# RF	Type: Studded Port (Hot), Flange (Cold)
	Intermed.					
Weights- Plates:	1 2,564	kg	Frame: 1 4,354	kg	Total Flooded: 1 8,396	kg Empty: 1 6,918 kg

Frame Material	SA-516-70N	Tie Bars Material	SA-193 B7
Plate Material	SA-240-316	Shroud Material	304 SS
Gasket Material	EPDM (Peroxide cured)	Gasket Type	Clipon
Nozzle Material	N/A	Nozzle Lining Material	316 SS
Bolts/Nuts Material:	Internal: SA-193-B7M / SA-194-2HM	External:	SA-193-B7 / SA-194-2H

Construction of One Unit

Pass No.		1	2	3	4
No. of Channels per Fluid		166			
No. of Plates		333			
Plate Model		Dura Flow			
Chevron Angle		1 29 , 60			
Surface Area Enhancement Factor		N/A			
Plate Materials		SA-240-316			
Plate Thickness	mm	0.6			
Plate Spacing	mm	3			
Area per Plate	m2	1.34 (Effective)			
Port Diameter	in	12"			
Vertical Distance between Port Centres	mm	1763			
Horizontal Distance between Port Centres	mm	1 486			

Frame Size: L x W x H	1 3353 x 1034 x 2774	mm	Plate Size	1 2134 x 852	mm		
Code Requirements	1 ASME Sect. VIII, Div. 1	Stamp	YES	API 662	YES	CRN / ABSA Registration	YES
Remarks:							

User 5		User 9	
User 6		User 10	
User 7		User 11	
User 8		User 12	

Notes

Plate Heat Exchanger Data Sheet Ref.: EJW50592/1 (C)

Invensys APV

Duty:	Lean/Rich Exchanger		REV 02
			Item No: 52-E-3A/B/C
PHE Type:	B134	Engineer:	EJW
Quotation No:	C5EW189WS	Date:	2005.May.09

Process Data		Hot	Cold
Fluid		Lean DEA	Rich DEA
Mass Flow Rate	Kg/s	216.66	226.21
Volume Flow Rate	l/s	226.15	219.22
Inlet Temperature	°C	126.4	53.3
Outlet Temperature, Duty	°C	76.6	104.4
Pressure Drop, calculated	kPa	35	37
Heat Exchange Rate, Duty	kW	43194.44	
Design (Duty) HTC	W/°C m^2	4120.5	
Clean HTC	W/°C m^2	4535.3	
% Difference in HTC		10.1%	
Fluid Volume in PHE	l	790.7	790.7

Fluid Properties		Hot	Cold
Density	kg/(m^3)	978.5	1011.5
Specific Heat Capacity	kJ/kg °C	3.848	3.736
Thermal Conductivity	W/m °C	0.480	0.447
Inlet Viscosity	mPa s	0.35	1.19
Outlet Viscosity	mPa s	0.80	0.46

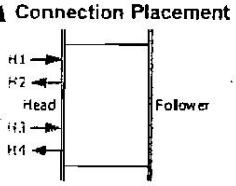
Plate Heat Exchanger Specifications					
PHE Type		B134			
Frame Type / Size		M-20 ser2/3. Painted Floor Mount Tie:CS, Carry:SS, max. 455 plates			
Dimensions (H*W*L)	mm	2774x1035x3364			
Total Number of Plates		333			
Total Active Area	m^2	443.54			
Hot Side Flow Arrangement		1*166			
Cold Side Flow Arrangement		1*166			
Plate Material		0.6 mm SS 316 SA240			
Gasket Material		EPDM p.c. Paraclip			
Hot Side Connection - Inlet	H1	NPS 12 Studded SS 316L Class 300 ANSI B16.5			
Hot Side Connection - Outlet	H4	NPS 12 Studded SS 316L Class 300 ANSI B16.5			
Cold Side Connection - Inlet	H3	NPS 12 Flange (RFWN) SS 316L Class 300 (Mates With) ANSI B16.5			
Cold Side Connection - Outlet	H2	NPS 12 Flange (RFWN) SS 316L Class 300 (Mates With) ANSI B16.5			
Design Code		A.S.M.E. VIII Div. 1			
Certificate					
Design Temperature	°C	Max.	175	Min.	-29
Design Pressure	kPa		1710		
Test Pressure	kPa	Balanced	2223	Differential	2223
Mass	kg	Flooded	8491	Empty	6918
Approx. Shipping Mass & Volume		Std Packing		kg	m^3

Accessories
AutoCAD Drawing w/ Frame Dimensions (1); ASME Inspection and U Stamp (1); Standard Paint APV Blue (APV3196) (1); Spray Deflector (1)

PROFESSIONAL ENGINEER LICENSED O.W. SHANOUDA 12/23/2005 PROVINCE OF ONTARIO

APEC Kiev
TAG NO. 52-E-3A/B/C
REV. 3
VDC NO. 44
P.O. CONTROL NO. 0652
CONTRACT NO. 383-1296
103933

Connection Placement



Remarks

CRN & API662. Shear stress, hot/cold, is 20/30 Pa. Plate gap is 3.0 mm.

REVIEWED BY DATE 17-JAN-06

Purchaser's review and/or release for fabrication shall not be construed as relieving seller of any obligation or responsibilities with respect to these documents or the items to be furnished by seller pursuant thereto.

- [ ] VC RELEASED FOR FABRICATION-CORRECT & RESUBMIT
- [ ] VN NOT RELEASED FOR FABRICATION-CORRECT & RESUBMIT
- [ ] VV VOID-SEE COMMENTS ON DOCUMENTS
- [ ] VEF-FINAL-ELECTRONIC FILES
- [ ] EO-DO NOT ISSUE THIS REVISION SUPERCEDED BY ANOTHER REVISION
- [x] VF FINAL-DO NOT RESUBMIT-NOT RETURNED TO VENDOR
- [ ] VFC FINAL WITH COMMENT-DO NOT RESUBMIT
- [ ] VI FINAL-INFORMATION ONLY
- [ ] VM FINAL, MANUAL(S)-NOT RETURNED TO VENDOR

invensys APV

ENGINEER: Kelly Rouse
DATE: 12-Dec-05
CALC NO.: B134-2005-602,603 REV NO.: 00

PRESSURE VESSEL CALCULATIONS

FOR AN

APV PLATE HEAT EXCHANGER

IN ACCORDANCE WITH THE

ASME BOILER AND PRESSURE VESSEL CODE

SECTION VIII, DIVISION 1

2004 EDITION

HEAT EXCHANGER MODEL:	B134 MGS-20	
REFERENCE DRAWING NUMBER:	B134M20B-01	
MATERIAL NUMBER(S):	2005-602 2005-603	
DESIGN PRESSURE:	248.00	psi
TEST PRESSURE:	323.00	psi
MAXIMUM DESIGN TEMPERATURE:	392.00	F
MINIMUM DESIGN METAL TEMPERATURE:	-20.00	F

P.O. NO: CN0032

TAG / ITEM NO.: 52-E-2A/B & 52-E-3A/B

LICENSED PROFESSIONAL ENGINEER
O.W. SHANOUDA 13933
PROVINCE

Kiewit APEC

CONTRACT NO.	P.O. CONTROL NO.	VOC NO.	REV.	TAG NO.
583-1296	0932	72	0	52-E-2A/B

REVIEWED BY — DATE: 12-JAN-06

Purchaser's review and/or release for fabrication shall not be construed as relieving seller of any obligation or responsibilities with respect to these documents or the items to be furnished by seller pursuant thereto.

- [ ] VC RELEASED FOR FABRICATION-CORRECT & RESUBMIT
- [ ] VN NOT RELEASED FOR FABRICATION-CORRECT & RESUBMIT
- [ ] VV VOID-SEE COMMENTS ON DOCUMENTS
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- [X] VFC FINAL WITH COMMENT-DO NOT RESUBMIT
- [ ] VI FINAL-INFORMATION ONLY
- [ ] VM FINAL. MANUAL(S)-NOT RETURNED TO VENDOR

Reviewed By
MAR 09 2006