tkIS India / Vendor

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-sbumitted after revision. This drawing should be revised only to the extent of tkIS India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.

This approval / review does not absolve the supplier from the full responsibility for design and fabrication.

Date : ___/___/_____ Name : _____

tkIS India / Owner / Client

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- ☐ 6 Reviewed as Noted / Resubmit

Date : ___/___/_____ Name : _____

Rev	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
00		Issued For Enquiry	03.12.18	HTS	04.12.2018	SPT	04.12.2018	SKM	

Barcode

Category Code

Plant	Client	Contract Code	Document ID	Contract No.
350 MTPD Caustic Soda Expansion	**PACL**	**PACL- 350 TPD EXPN**	**0215-EQS-31-EC-0002**	**66- 0215-700**

thyssenkrupp

DATA SHEET FOR PLATE HEAT EXCHANGER (Case I - 350TPD Caustic Soda Plant)

Catholyte Heat Exchanger-I
Item No. 31E01N

pacl
PACL LIMITED

SN	Rev				SN			
		Quantity (operation / stand-by)	1		13	Part	Material	Remarks
1		Arrangement parallel	Series	Stand-by	14	Plates	Nickel	
2		Surface area / exchanger (Eff./Total) m2 (Note-1)	*	*	15	End plate	SA 516 Gr.60/ 70	
3		Number of exchangers per unit	1		16	Frame	SA 516 Gr.60/ 70	
4		Number of plates, assemb. / max	*	*	17	Bolts / Nuts (Fluid 1)	SA 193 GR.B7 / 194 GR. 2H	With Cd
5		Min. plate thickness mm	0.6		18	Bolts / Nuts (Fluid 2)	SA 193 GR.B7 / 194 GR. 2H	electroplating
6		Type	Plate Type		19	Gaskets	EPDM	
7		Material (process side)	Nickel		20	Nozzle flanges fl.1	*	
8		Model No.	*		21	Nozzle flanges fl.2	*	
9		Supplier	*		22	Nozzle pipe fl.1	Nickel Lined	
10		Weight, delivery kg	*		23	Nozzle pipe fl.2	SS316 Lined	
11		Weight with process fluid kg	*		24	Flanges acc. to	ASME B16.5, 150#	
12		Weight, water filled kg	*		25	Design code	ASME SEC-VIII, DIV.1	

26 Remarks:

27 (*) - Data to be filled by Vendor

28 INSULATION REQUIRED (Y / N) : N INSPECTION BY : CLIENT / tkIS(India)

29 Note 1 : Heat exchanger is to be designed for 10% excess area over dirty heat transfer coefficient.

30 Note 2: Heat exchanger is to be designed for flow of 300840 kg/hr @0.5 kg/cm2 pressure drop

31

				Fluid 1		Fluid 2	
32							
33		Process fluid		32% CAUSTIC		STEAM / CONDENSATE	
34							
35		physical condition , in / out (S)olid, (L)iquid, (V)apour, (G)as		LIQUID	LIQUID	GAS	LIQUID
36		Class of hazard		Corrosive			
37		pH-value					
38		H2-part, press., in/put	kg/cm2 a				
39		Design temperature	°C	135		135	
40		Design pressure	kg/cm2 g	8.0		8.0	
41		Test pressure	kg/cm2 g	*		*	
42							
43		OPERATING CONDITIONS PER UNIT		Fluid 1		Fluid 2	
44				Inlet	Outlet	Inlet	Outlet
45		Mass flow , total (See Note 2)	kg/h	143750		4701.5	
46		Mass flow , vapor / gas	kg/h				
47		Mass flow, steam	kg/h			4701.5	
48		Mass flow, inerts	kg/h				
49		Mass flow, liquid	kg/h	143750	143750		
50		mass flow, water	kg/h				4701.5
51		operating temperature	°C	65.00	85.0	120.0	120.0
52		Operating pressure	kg/cm2 g	3.0		1.0	
53		LIQUID					
54		Fouling factor	hr m2 °C/kcal	1316.0	1310.0		943.0
55		Specific heat	kcal/kg °C	0.8637	0.860		1.0140
56		Thermal conductivity	kcal/hr m °C	0.5970	0.6100		0.5880
57		Dynamic viscosity	cP	2.9000	2.2000		0.2320
58		Heat of evaporation	kcal/kg °C				
59		Boiling point	°C				
60		Solidification point	°C				
61		STEAM / GAS					
62		Molar weight	kg/kmol			18	
63		Density	kg/m3			1.130	
64		Specific heat	kcal/kg °C			0.520	
65		Thermal conductivity	kcal/hr m °C			0.0234	
66		Dynamic viscosity	cP			0.0129	
67		Condensation temperature	°C				
68		Condensation enthalpy	kca/kg			525.90	
69		Fouling factor	hr m2 °C/kcal	0.000050		0.00010	
70		Velocity (mean)	m/s	*		*	
71		Pressure drop , admissible / calculated	kg/cm2	0.5 (Note 2) / *		0.1 / *	
72		Number of passes		*		*	
73		Corrected temperature difference	°C	*			
74		Heat duty	kcal/ hr	2472500			
75		(Overall) Heat transf. coeff. , clean / dirty	kcal/ hr m2 °C	* / *			

FILE NAME :

Plant	Client	Contract Code	Document ID	Contract No.
350 MTPD Caustic Soda Expansion	**PACL**	**PACL- 350 TPD EXPN**	**0215-EQS-31-EC-0002**	**66- 0215-700**

thyssenkrupp

DATA SHEET FOR PLATE HEAT EXCHANGER (Case II- 500TPD Caustic Soda Plant)

Catholyte Heat Exchanger-I
Item No. 31E01N

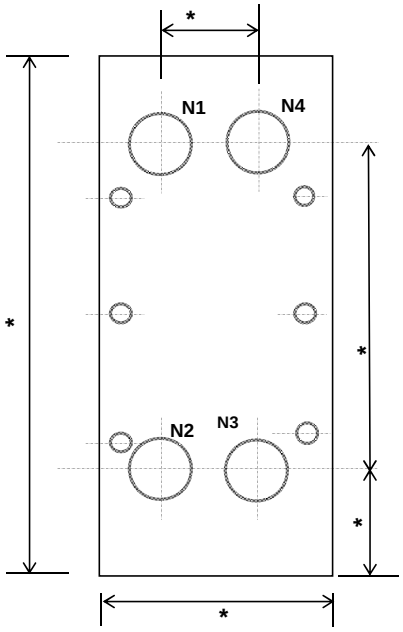
pacl
PACL LIMITED

SN	Rev	Quantity (operation / stand-by)	1	13	Part	Material	Remarks
1		Note 1 : Heat exchanger is to be designed for 10% excess area over dirty heat transfer coefficient.					
2		Note 2: Heat exchanger is to be designed for flow of 497800 kg/hr @0.5 kg/cm2 pressure drop					
3							

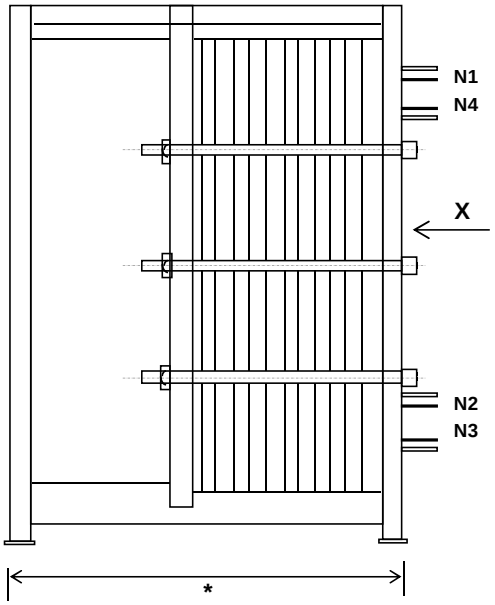
SN	Rev			Fluid 1		Fluid 2	
4							
5		Process fluid		32% CAUSTIC		STEAM / CONDENSATE	
6							
7		physical condition , in / out (S)olid, (L)iquid, (V)apour, (G)as		LIQUID	LIQUID	GAS	LIQUID
8		Class of hazard		Corrosive			
9		pH-value					
10		H2-part, press., in/put	kg/cm2 a				
11		Design temperature	°C	135		135	
12		Design pressure	kg/cm2 g	8.0		8.0	
13		Test pressure	kg/cm2 g	*		*	
14							
15		OPERATING CONDITIONS PER UNIT		Fluid 1		Fluid 2	
16				Inlet	Outlet	Inlet	Outlet
17		Mass flow , total (See Note 2)	kg/h	205357		6716.5	
18		Mass flow , vapor / gas	kg/h				
19		Mass flow, steam	kg/h			6716.5	
20		Mass flow, inerts	kg/h				
21		Mass flow, liquid	kg/h	205357	205357		
22		mass flow, water	kg/h				6716.5
23		operating temperature	°C	65.00	85.0	120.0	120.0
24		Operating pressure	kg/cm2 g	3.0		1.0	
25		LIQUID					
26		Density	kg/m3	1316.0	1310.0		943.0
27		Specific heat	kcal/kg °C	0.8637	0.860		1.014
28		Thermal conductivity	kcal/hr m °C	0.5970	0.6100		0.5880
29		Dynamic viscosity	cP	2.9000	2.2000		0.2320
30		Heat of evaporation	kcal/kg °C				
31		Boiling point	°C				
32		Solidification point	°C				
33		STEAM / GAS					
34		Molar weight	kg/kmol			18	
35		Density	kg/m3			1.130	
36		Specific heat	kcal/kg °C			0.520	
37		Thermal conductivity	kcal/hr m °C			0.0234	
38		Dynamic viscosity	cP			0.0129	
39		Condensation temperature	°C				
40		Condensation enthalpy	kca/kg			525.90	
41		Fouling factor	hr m2 °C/kcal	0.000050		0.00010	
42		Velocity (mean)	m/s	*		*	
43		Pressure drop , admissible / calculated	kg/cm2	0.5 (Note 2) / *		0.1 / *	
44		Number of passes		*		*	
45		Corrected temperature difference	°C	*			
46		Heat duty	kcal/ hr	3532150			
47		(Overall) Heat transf. coeff. , clean / dirty	kcal/ hr m2 °C	* / *			

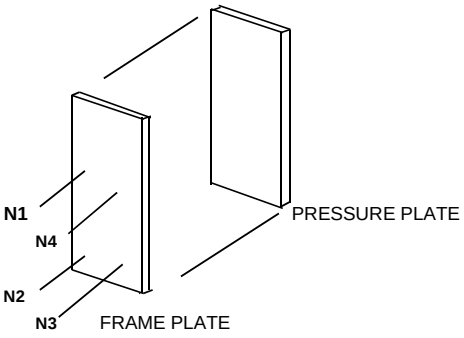
FILE NAME :

SN	Rev.	
1		1. Vendor to do thermal design of the exchanger for both Case 1 & 2. Present selection of no. of plates
2		is to be done to Case 1 with provision of upgradation to case 2 (including consideration of additional space,
3		foundation plan, load design, nozzle sizing and piping orientation)
4		2. Exchanger shall not be dismantled after final hydrotest.
5		
6		3. Derusting and painting as per Manufacturer's standard. However vendor has to take prior approval of
7		procedure & painting specification from tkIS(India)/Client.
8		
9		4. Performance of heat exchanger shall be proved by vendor at site.
10		
11		5. Supply of foundation bolts, lifting lugs (in-built type) & earthing cleats shall be by vendor.
12		
13		6. Vendor to guarantee performance (i.e. thermal performance and pressure drop), suitability of materials offered
14		(in fluid contact) and mechanical design of the unit. Performance test run shall be demonstrated at site for
15		72 hours. In case of any discrepancy during guarantee period, Vendor shall replace the defective parts or
16		the whole heat exchanger free of cost in order to meet guaranteed performance.
17		
18		7. In case of gasket failure, vendor shall replace full set of gaskets free of cost, during the period of 18 months
19		from startup or 24 months from date of despatch whichever is earlier.
20		
21		8. Friction type spanner shall be supplied by the vendor for tightening bolts.
22		
23		9. Extra length of the tightening stud shall be protected by providing suitable sleeve of PVC / rubber /any
24		other suitable non-corrosive material
25		
26		10. Following inspection / tests shall be carried out at the vendors works in the presence of tkIS(India) / client.
27		a) Material identification & checking of material test certificates.
28		b) Checking of X-ray report as applicable and verification of internal quality testing documents.
29		c) UT / DP test for weld joints.
30		d) Final hydrotest
31		e) Dimensional checking
32		f) Checking of plate thickness (0.6mm minimum).
33		
34		11. Rack of heat exchanger is designed for 20% extra plates (spare plates) minimum over case 2 requirement
35		
36		12 Commissioning spare parts:
37		a) Ring gasket for end plate : 1 set (100% per exchanger)(If applicable)
38		b) Flow gasket: 2% (atleast 5 nos. per exchanger)
39		c) Nuts & washers for tie rods: 2 nuts + 2 washers per exchanger
40		d) Gasket for start plate: min. 1 no. per exchanger (If Applicable)
41		13. Spare for 2 years trouble free operation shall be quoted separately.
42		2 years operation spare parts:
43		a) Ring gasket for end plate : 1 set (100% per exchanger)(If applicable)
44		b) Flow gasket: 2% (atleast 5 nos. per exchanger)
45		c) Nuts & washers for tie rods: 2 nuts + 2 washers per exchanger
46		d) Gasket for start plate: min. 1 no. per exchanger (If Applicable)
47		
48		14. Personnel protection sheet of acrylic or other suitable material shall be provided for plates.
49		
50		15. Vendor to fill up data marked with '*'.
51		
52		16. Minimum nozzle loads shall be considered as per API-662 Part1, Cl.7.7.10 Table 2.
53		Vendor shall check & incorprate revised loads if any during detail engineering without any extra cost if
54		thicknesses are not changing.
55		
56		17. The equipment shall be guaranteed for satisfactory performance as well as any sorts of manufacturing defects
57		for a period of 18 months from the date of commissioning or 24 months from the date of last despatch,
58		whichever is earlier.
59		
60		18. Supplies shall be carefully guaranteed against any manufacturing defect/ poor workmanship quality etc. for a
61		period of 18 months from the date of commissioning or for 24 months from the date of delivery whichever is
62		earrlier. During this period vendor will arrange to repair/ replace any defective part free of cost or replace
63		complete set, if required.
64		
65		19. Vendor shall provide all technical assistance for supervision of commissioning at free of cost.
66		
67		20. Vendor shall not use any Chinese made material or any part of the same



VIEW 'X'





Notes:

1) Vendor to confirm data marked ' * ' & furnish in offer.
2) Nozzle orientation and Designation with Nozzle Symbol given by tkIS in the Sketch and nozzle table below shall be followed by vendor.Nozzle orientation given by vendor shall be kept same after order placement during execution of the project.
3) If vendor proposal consists of non standard flanges (Other than B16.5) for nozzles, vendor shall also supply companion flange, spool of appx.75mm of process suitable material with gaskets & fasteners including spares.
4) Vendor shall take necessary precautions while deciding nozzle sizes with respect to fouling of nozzle flanges with PHE supporting arrangements.

Nozzle symbol	Designation	DN	NB	Standard	Flange Type	Flange facing	Nozzle length	Remarks
N1	STEAM INLET	*	*	ASME B16.5	*	RF	*	
N2	CONDENSATE OUTLET	*	*	ASME B16.5	*	RF	*	
N3	CATHOLYTE INLET	*	*	ASME B16.5	*	RF	*	
N4	CATHOLYTE OUTLET	*	*	ASME B16.5	*	RF	*	

FILE NAME :

Plant	Client	Contract Code	Document ID	Contract No.
350 MTPD Caustic Soda Expansion	**PACL**	**PACL- 350 TPD EXPN**	**0215-EQS-31-EC-0002**	**66- 0215-700**

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INDEX OF APPLICABLE CODES AND STANDARDS

Catholyte Heat Exchanger-I
Item No. 31E01N

pacl
PACL LIMITED

1		**1 DESIGN CODES**											
2		X	ASME Code Section VIII, Division 1 Edition 2017										
3			ASME Code Section VIII, Division 2 Edition 2017										
4			TEMA Standards, Class R, 2007- 9th Edition										
5			API 650, 12th Edition March 2013 with Addendum 2, January 2016										
6			API 620, 12th Edition October 2013 with Addendum 1, November 2014										
7		X	API 662 Part 1, 1st Edition February 2006 with Reaffirmed, February 2011										
8			EN 13121-3 : 2010A										
9			IBR 1950 with amendment Dec. 2008										
10		X	Manufacturer's Standards										
11		**2 REFERENCE STANDARDS**											
12			ESA 09 AU-ST-02(M)	Vessels & Equipment: Pressure Vessels General Specification									
13			UN 2000-01 Part 2(M)	Atmospheric vessels, general specification									
14			UN 2000-01 Part 3(M)	Vessels and equipment, field fabrication, general specification									
15			UN 2000-05 Part 1(M)	Saddle supports for horizontal steel vessels									
16			UN 2000-05 Part 4(M)	Supports For Vertical Steel Vessels; Skirt									
17			UN 2000-05 Part 5(M)	Supports For Vertical Steel Vessels; Legs									
18			UN 2000-05 Part 6	Supports For Vertical Steel Vessels; Brackets (Lugs)									
19			UN 2000-06 Part 2(M)	Clips for ladders, davits and platforms									
20			UN 2000-06 Part 3(M)	Clips for guide and support brackets for piping, type C									
21		X	UN 2000-09 Part 1(M)	Name plate for vessels									
22			UN 2000-09 Part 2(M)	Name plate for tanks									
23			UN 2000-11 Part 1(M)	Swivel devices for inspection openings									
24			UN 2002-01 Part 1	Vessels and equipment of glass fibre reinforced plastics; Technical delivery condition									
25			UN 2002-02 Part 1	Vessels and equipment of glass fibre reinforced plastics, with lining; Technical delivery condition									
26			UN 2002-03 Part 1	Vessels and equipment of glass fibre reinforced plastics; Typical configuration									
27			UN 2002-04	Transport and erection instructions for vessels and tanks of GRP									
28		X	UN 2003-01	Earthing connections for vessels and equipment									
29			UN 2004-05(M)	Internals; Vortex breakers, feed deflectors and ladder rungs									
30			UN 2004-06(M)	Insulation clips for vertical steel vessels									
31			UN 2100-01 Part 1	Tubular heat exchangers, general specification									
32			UN 2100-03(M)	Jack screw bosses at tube sheet for heat exchangers									
33			UN 5222-02 Part 1(M)	Fractionating Trays; General Specification									
34			UN 5222-02 Part 2(M)	Vessels, support grid									
35			UN 5222-02 Part 3(M)	Vessels, hold down grid									
36			UN V416-01 Part 1	Welding, welded joints for vessels and equipment, requirements									
37			UN V416-01 Part 2	Welding, welded joints for vessels and equipment, examples									
38			UN V416-02(M)	Vessels and equipment, tube-to-tubesheet joints									
39			UN V416-03 Part 1	Vessels and equipment, surface treatment of austenitic stainless steels after welding									
40			UN 2000-01 Part 1	Engineering of steel structures; design, fabrication, materials									
41													
42													
43													
44													
45													
46													
47													
48													
49													
50													
51		**3 CLASSIFICATION GROUP and LEAKAGE CLASS**											
52			Vessel	Group									
53			Heat Exchanger	Shell Side Group		Tube Side Group		Leakage class DK					
54			Not Applicable										
55		**4 FATIGUE LOADING**											
56			Design	No. of load cycles		from		kg/cm2 g	to				kg/cm2g
57		**Remarks:**											

1			**General**
2		X	Stress analysis shall be performed by the manufacturer in accordance with design specifications
3		X	Specified wall thicknesses are minimum values and shall be increased if required by stress calculation
4		X	Nozzle necks shall be least DN 50/ 2". They shall be reduced to the required nominal flange size if necessary.
5		X	Bolts and nuts for joints with tapped holes have to be supplied by the vessel manufacturer.
6			
7			**Supplies shall include the following items**
8			Base ring template
9			Clips and pads for ladders and plattforms
10			Clips for davits
11			Davits for manholes
12			Clips and pads for pipe supports
13			Supports for insulation
14			Supports for fireproofing insulation acc. to UN 2000 - 05 part 4
15			Additional 1 sets of gaskets for flanges with cover and blind flanges
16			Additional 10% of bolts and nuts, as spare
17		X	Lifting lugs for erection
18			Lifting trunnions for erection
19		X	2 separate earthing connections to be provided 180 degree apart resp. 1 per saddle, if not otherwise specified
20		X	All internals
21			Set of glasses and gaskets for water gauges
22			Demister
23			Platforms and ladders plus bolts and nuts, as spare
24		X	Spare parts for 2 years to be quoted separately.
25			Bolts, nuts and gaskets for connecting piping
26			Test flange (quote separately)
27			Lifting lugs on channels and bonnets
28		X	Name plate
29		X	Anchor Bolts
30		X	For applicable standards see page ' index of applicable Codes and standards'
31		X	Commissioning spare parts
32			
33			**Additional requirements for heat exchangers**
34			Tubes to be welded into tube sheet and tested according to UN V416 - 02 part 1, Leakage class
35			Tubes to be expanded after welding
36			Tubes to be fixed by expansion
37			Expansion with grooves in tube sheet holes
38			Tube bundle to be equipped with 2 slide rails
39			Tube bundle to be equipped with sealing strips
40			For stacked heat exchangers an experimental assembly and pressure test shall be performed
41			Protection device for expansion bellows
42			
43			Pulling Lugs for tube bundle
44			Jackscrews and jack bosses according to UN 2100 - 03 part 2
45			Tube holes in baffles and support plates to be max. 0.4 mm over outer diameter of tubes
46			Holes' diameter in tube sheet according to standard fit
47			
48			
49			Remarks:

Plant	Client	Contract Code	Document ID	Contract No.
350 MTPD Caustic Soda Expansion	**PACL**	**PACL- 350 TPD EXPN**	**0215-EQS-31-EC-0002**	**66- 0215-700**

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SUMMARY OF ENGINEERING AND FINAL DOCUMENTS

Catholyte Heat Exchanger-I
Item No. 31E01N

pacl
PACL LIMITED

SN	Pos.					
		The following engineering and final documents shall be furnished by the manufacturers :				
1		**Version and delivery date shall be specified**				
2						
3		**1.0 For engineering and approval**	**Quantity**			
4	Pos.	**Documents**	**Reproducible**	**Copy**	**Version**	**Delivery Dt**
5	1	Assembly drawing - Arrangement drawing & QAP	1)	1 soft	II	B
6	2	Foundation plan - Load plan		1 soft	II	B
7	3	Workshop drawing with part list			II	
8	4	Engineering data and specifications (tkIS(India) DATA SHEETS FILLED)		1 soft	II	A, B
9	5	Piping plan or piping diagram / P&ID				
10	6	Electrical diagrams (MOTOR DRAWINGS), Instrument list (Make / Type)				
11	7	Delivery schedule for equipment		1 soft	II	D.1
12	8	Sketch for equipment transport				
13	9	Erection instructions				
14	10	Stress analysis (for information)				
15	11	Product catalogue, Instrument Specs. Including Instruments & G.A. for Panel.				
16	12	Reference list for similar equipment				
17	13	Documents bearing tkIS(India)/Client notes shall be resubmitted	As Indicated Above			C
18		**2.0 SPARE PARTS**				
19	1	Quotation for two years operation & commissioning spares		1 soft	II	A
20	2	Spare part list with itemized drawing or sketches		1 soft	II	B
21						
22		**3.0 FINAL DOCUMENTS**				
23	1	Final documents as listed under 1.0		4 Hard+3soft	II	G
24	2	Instructions for operation and maintenance		4 Hard+3soft	II	
25	3	Erection instructions		4 Hard+3soft	II	
26	4	Table of lubricants and lubrication schedule				
27	5	Test certificates for explosion proof items of equipment				
28	6	Summary of antifriction bearings				
29	7	Stress analysis				
30	8	Exhaustive Component List				
31	9	Test Certificate of bought-out items				
32	10	Panel Wiring Diagram				
33	11					
34	12					
35		**4.0 INSPECTION**				
36	1	Shop inspection certificate		4 Hard+1soft	II	E
37	2	Inspection reports to DIN 50 049/3.1A-3.1C		4 Hard+1soft	II	E
38	3	Inspection reports issued by inspection authority such as TUV				
39	4	Inspection reports, stress-relieving diagrams, etc.				
40	5					

41	**5.0 Explanation of figures listed in column version**		Notes pertaining to column "delivery date""
42	I	Lettering or wording in German	A To be submitted with quotation
43			B 15 days after order placements
44	II	Lettering or wording in English	C Two weeks after return of documents
45			D One month after order placement, thereafter monthly
46	III	Lettering or wording in German and English	E Not later than date of final inspection
47			F One month after final inspection ; to be submitted with shipping
48	IV	Lettering or wording in German	documents if the equipment has to be shipped
49			G After final release, but not later than 4 weeks prior to final inspection 1 soft copy to KCIL, 1 soft copy to tkIS(I)-HO, 1 soft copy to tkIS(I)- site

50	**6.0 REMARKS :**
51	1) Standard size DIN A4 and smaller on white sheets, larger sizes on reproducibles
52	NOTES :
53	
54	
55	
56	
57	
58	

FILE NAME :