TEST Reg. nr. 300

DANISH TECHNOLOGICAL INSTITUTE

300-VELA, P-Lab.

COMPLIANCE TEST REPORT - ECO 641/2009

Report no.:
2001384 - 300-P-Lab-13-004

Product:
Circulator: **IMP Pumps - NMT, 25/60-180**

Customer:
Energistyrelsen (The Danish Energy Agency)

Date:
12 December 2013

Consultants:
Mads Peter R. Hansen, Sandie B. Nielsen

Compliance to:
COMMISSION REGULATION (EU) No. 641/2009 of 22 July 2009.
Implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for glandless standalone circulators and glandless circulators integrated in products
Also taking into account the ammendmend 622/2012 of 11 July 2012.

Compliance result:	0,22 ≤ 0,24 ? = **PASSED**

ECO design max.	Declared EEI	Declared + 7%	Calculated EEI:
≤ 0,27	**≤ 0,22**	**≤ 0,24**	**0,22 ± 0,01**

Energy and Climate
Centre for Energy Efficiency & Ventilation

COMPLIANCE TEST REPORT - ECO 641/2009

DANISH TECHNOLOGICAL INSTITUTE

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Date:	12 December 2013	Page:	2 of 6
Report no.:	2001384 - 300-P-Lab-13-004	Initials:	SBN/MPRH
File no.:	_	Enclosures:	

Customer:	Contact person:	Peter Nielsen
	Company:	Energistyrelsen (The Danish Energy Agency)
	Address:	Amaliegade 44
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	Phone:	+45 33 92 67 35
	Mail:	pen@ens.dk
Component:	Brand:	IMP Pumps
	Type:	NMT
	Model:	25/60-180
	Serial no.:	979522047
Dates:	Component received:	October 2013
	Component testet:	26 November 2013

P-Lab procedure: **TP 01**:
Product testet following test standard DS/EN 16297-1 and DS/EN 16297-2
Including requirements in DS/EN ISO 9906:2012 - grade 1

Remarks: The pump has no indication of benchmark on neither pump nor package as prescribed: "The benchmark for the most efficient circulators is EEI 0.20"

Conditions: The test results apply to the tested products only.

This test report may be reproduced in extract only if the Laboratory has approved the extract in writing.

Division/Centre: Danish Technological Institute
Energy and Climate
Pump Test Laboratory, P-Lab Taastrup

Date: 12 December 2013

Signature:

Sandie B. Nielsen
Electrical Engineer

Signature co-reader:

Per T. Jespersen
Mechanical Engineer

Objective:

The objective of this report is to document the energy efficiency index EEI of a given circulator, measured and calculated following conditions as stated in DS/EN ISO 9906:2012, DS/EN 16297-1, & 2

Compliancy to COMMISION REGULATION (EC) No 641/2009 with regards to ecodesign requirements for glandless standalone circulators and circulators integrated in products are subsequently checked.

Description of test:

The test object is mounted in the pump test facility at Danish Technological Institute, Taastrup.
The dutypoint of maximum hydraulic performance is determined, and the circulator is run in this dutypoint until steady state condition is obtained. Normally the object is run "over night" (> 12 hours).

Following this the full pump curve is measurered in not less than 14 duty points.
All measured values are collected and averaged in each duty point.

Detailed information about this measurement are to be found at page **4** of this report

The partial load points (dutypoints) are determined and the pump is programmed to optimized duty, followed by measurements in these dutypoints. All data are finally used for EEI calculation

Detailed information about this test and EEI calculation are to be found at page **5** of this report

Test object pictures:

QA Equip. no.:

Primary equipment used pump test:

Input power - electrical:	Zimmer LMG-450, 3 ph. power analyzer, class 0.1	76028
Output power - hydraulical:	Siemens MAGFLOW, MAG 5100W, 0-5 m3/h	6997
	Siemens Sitrans P, scale: 0 - 500 mbar	2719

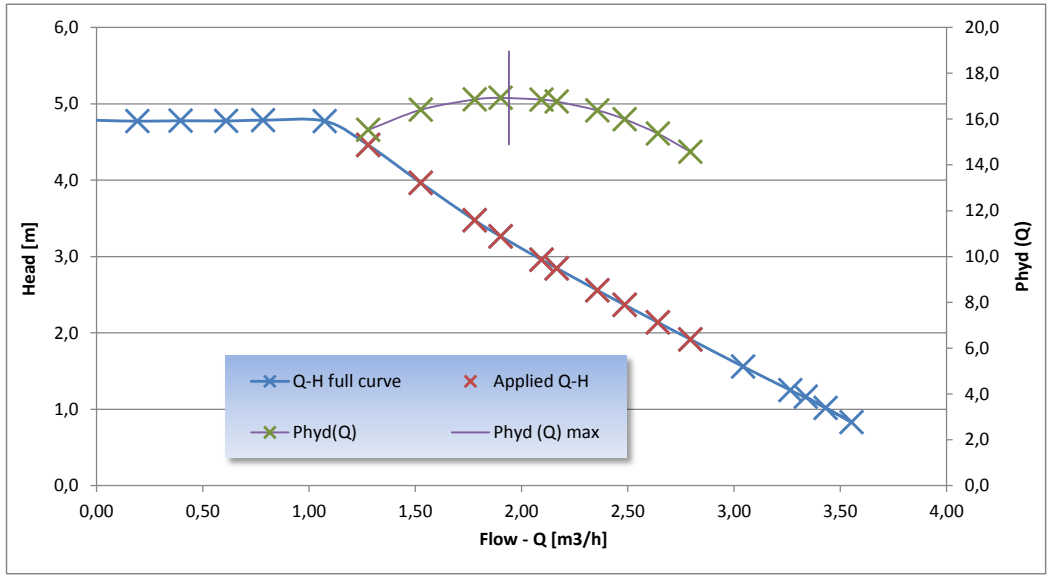
Averaged values: 12 **values per point.** **No. of dutypoints:** 21

Testing of hydraulic characteristic following: DS/EN ISO 9906, Grade 1

After +10 hours warmup - total curve duration approx. 2 hours

Ref: 374

	C	D	K	J	I	T	U	AC	
Startfelt:	t_rum - [°C]	t_ex_frem - [°	Flow - [m3/h]	p_diff - [bar]	p_suge	L4 volt - [V]	L4 amps - [A	P1 1ph - [	No. calc
101	20,1	21,7	3,34	0,114	2,12	230,0	0,44	50,5	1
114	20,0	21,8	3,55	0,081	2,11	230,0	0,44	50,4	1
127	19,9	21,8	3,43	0,100	2,11	230,0	0,44	50,4	1
140	19,9	21,8	3,27	0,122	2,11	230,0	0,44	50,3	1
153	20,0	21,8	3,04	0,153	2,11	230,0	0,44	50,3	1
166	20,2	21,8	2,79	0,188	2,11	230,0	0,44	50,4	1
179	20,1	21,8	2,64	0,209	2,11	230,0	0,44	50,4	1
192	20,1	21,8	2,49	0,232	2,11	230,0	0,44	50,4	1
205	20,1	21,8	2,36	0,250	2,12	230,0	0,44	50,4	1
218	20,1	21,8	2,17	0,279	2,12	230,0	0,44	50,4	1
231	20,2	21,8	2,09	0,290	2,11	230,0	0,44	50,4	1
244	20,2	21,8	1,90	0,320	2,12	230,0	0,43	50,3	1
257	20,2	21,8	1,78	0,340	2,12	230,0	0,44	50,3	1
270	20,2	21,8	1,53	0,388	2,11	230,0	0,43	50,3	1
283	20,1	21,8	1,28	0,437	2,11	230,0	0,43	50,2	1
296	20,3	21,8	1,07	0,467	2,11	230,0	0,43	50,2	1
309	20,3	21,8	0,78	0,469	2,10	230,0	0,43	50,1	1
322	20,2	21,8	0,61	0,468	2,10	230,0	0,43	49,7	1
335	20,3	21,8	0,40	0,468	2,10	230,0	0,40	45,2	1
348	20,1	21,8	0,19	0,467	2,11	230,0	0,36	40,8	1
361	20,1	21,7	0,00	0,468	2,11	230,0	0,33	36,9	1



Measured values:

bar -> pascal

Water temp.	Flow [m3/h]	p_diff - [pascal]	P1 - [Watt]
21,7	3,34	11407	50,5
21,8	3,55	8140	50,4
21,8	3,43	9960	50,4
21,8	3,27	12236	50,3
21,8	3,04	15255	50,3
21,8	2,79	18757	50,4
21,8	2,64	20933	50,4
21,8	2,49	23172	50,4
21,8	2,36	25042	50,4
21,8	2,17	27867	50,4
21,8	2,09	28968	50,4
21,8	1,90	31963	50,3
21,8	1,78	34029	50,3
21,8	1,53	38828	50,3
21,8	1,28	43663	50,2
21,8	1,07	46740	50,2
21,8	0,78	46856	50,1
21,8	0,61	46768	49,7
21,8	0,40	46789	45,2
21,8	0,19	46733	40,8
21,7	0,00	46849	36,9

Calculated values:

Head [m]	Rho H_2O	Q x H	P_hyd [Watt]	Eta_tot [%]
1,16	997,8	3,9	10,6	21,0%
0,83	997,8	3,0	8,0	15,9%
1,02	997,8	3,5	9,5	18,8%
1,25	997,8	4,1	11,1	22,1%
1,56	997,8	4,7	12,9	25,6%
1,92	997,8	5,4	14,6	28,9%
2,14	997,8	5,6	15,4	30,5%
2,37	997,8	5,9	16,0	31,8%
2,56	997,8	6,0	16,4	32,6%
2,85	997,8	6,2	16,8	33,3%
2,96	997,8	6,2	16,9	33,5%
3,26	997,8	6,2	16,9	33,6%
3,47	997,8	6,2	16,8	33,4%
3,96	997,8	6,1	16,5	32,7%
4,46	997,8	5,7	15,5	30,9%
4,77	997,8	5,1	13,9	27,8%
4,78	997,8	3,8	10,2	20,4%
4,78	997,8	2,9	7,9	16,0%
4,78	997,8	1,9	5,1	11,4%
4,77	997,8	0,9	2,5	6,1%
4,78	997,8	0,0	0,0	0,0%

3. order equation for $H_{fit}(Q)$

x^3	x^2	x^1	x^0
-1,230E-01	9,972E-01	-4,141E+00	8,385E+00

3. order equation for $P_{hyd}(Q)$

x^3	x^2	x^1	x^0
-2,523E-02	-3,057E+00	1,215E+01	5,047E+00
-	-7,570E-02	-6,114E+00	1,215E+01

$Q_{100\%}$ - ($P_{hyd,r}$):	**1,94**	m^3/h
$P_{hyd,r}$:	**16,9**	Watt
$H_{100\%}$ - [$H_{fit}(Q_{100\%})$]:	**3,21**	m

Reference power, $P_{ref.}$: **45,7** Watt

$$P_{ref} = 1{,}7 \times P_{hyd,r} + 17 \times (1 - e^{-0{,}3 \times P_{hyd,r}})$$

Flow values tripled:

Flow:		
3,3	11,1	37,2
3,6	12,6	44,9
3,4	11,8	40,4
3,3	10,7	34,8
3,0	9,3	28,2
2,8	7,8	21,8
2,6	7,0	18,5
2,5	6,2	15,4
2,4	5,6	13,1
2,2	4,7	10,2
2,1	4,4	9,2
1,9	3,6	6,9
1,8	3,2	5,6
1,5	2,3	3,6
1,3	1,6	2,1
1,1	1,2	1,2
0,8	0,6	0,5
0,6	0,4	0,2
0,4	0,2	0,1
0,2	0,0	0,0
0,0	0,0	0,0

Averaged values: 13 **values per point.** **No. of dutypoints:** 21

Part load operating points following: DS/EN ISO 9906, Grade 1

After +10 hours warmup, full pump curve & determination of control curve

	C	D	K	J	I	T	U	AC	Ref: 395
Startfelt:	t_rum - [°C]	t_ex_frem - [	Flow - [m3/h]	p_diff - [bar]	p_suge	L4 volt - [V]	L4 amps - [A	P1 1ph - [	No. calc
101	16,2	18,7	2,16	0,268	2,10	228,4	0,39	49,2	1
115	16,3	18,7	1,96	0,249	2,09	228,5	0,33	41,3	1
129	16,1	18,7	2,03	0,257	2,10	229,0	0,35	44,3	1
143	16,2	18,7	1,96	0,250	2,09	228,4	0,33	41,5	1
157	16,1	18,7	1,93	0,246	2,10	227,6	0,32	40,2	1
171	16,2	18,7	1,50	0,207	2,10	228,0	0,21	26,6	1
185	16,1	18,7	1,50	0,206	2,10	227,9	0,20	26,4	1
199	16,2	18,7	1,38	0,197	2,10	228,4	0,18	23,4	1
213	16,1	18,7	1,58	0,213	2,09	229,4	0,22	28,8	1
227	16,0	18,7	1,50	0,206	2,10	230,6	0,20	26,5	1
241	16,0	18,6	1,02	0,171	2,10	231,4	0,13	16,1	1
255	15,8	18,6	1,00	0,170	2,10	232,1	0,13	15,8	1
269	15,7	18,6	0,98	0,168	2,09	231,6	0,12	15,3	1
283	15,8	18,6	1,00	0,170	2,09	231,6	0,13	15,7	1
297	15,9	18,5	0,96	0,168	2,10	231,8	0,12	15,1	1
311	15,8	18,5	0,53	0,140	2,10	231,7	0,08	9,3	1
325	15,8	18,5	0,52	0,139	2,10	232,3	0,08	9,1	1
339	15,9	18,4	0,52	0,139	2,10	232,3	0,08	9,1	1
353	15,8	18,4	0,49	0,137	2,10	232,3	0,07	8,8	1
367	15,9	18,4	0,44	0,134	2,10	232,3	0,07	8,3	1
381	15,8	18,4	0,44	0,134	2,10	231,8	0,07	8,3	1

$Q_{100\%}$:	1,94	m^3/h
$H_{100\%}$:	3,21	m

$Q_{75\%}$:	1,46	m^3/h	$H_{75\%}$:	2,80 m
$Q_{50\%}$:	0,97	m^3/h	$H_{50\%}$:	2,40 m
$Q_{25\%}$:	0,49	m^3/h	$H_{25\%}$:	2,00 m

Measured / Selected values:

$Q_{100\%}$:	1,93	m^3/h	$H_{100\%}$:	2,51	m	---	$P_{1,\ 100\%,\ meas}$:	40,2 Watt
$Q_{75\%}$:	1,38	m^3/h	$H_{75\%}$:	2,01	m	---	$P_{1,\ 75\%,\ meas}$:	23,4 Watt
$Q_{50\%}$:	0,96	m^3/h	$H_{50\%}$:	1,71	m	---	$P_{1,\ 50\%,\ meas}$:	15,1 Watt
$Q_{25\%}$:	0,44	m^3/h	$H_{25\%}$:	1,37	m	---	$P_{1,\ 25\%,\ meas}$:	8,3 Watt

Load profile, average compensated power, DS/EN 16297 part 2

$Q_{100\%}$:	L1 = 6%	$P_{100\%}$:	3,08	1,28	Compensated	$P_{L,\ weighted}$:	20,8 Watt
$Q_{75\%}$:	L2 = 15%	$P_{75\%}$:	4,91	1,40	Compensated	$P_{ref.}$:	45,7 Watt
$Q_{50\%}$:	L3 = 35%	$P_{50\%}$:	7,42	1,40	Compensated		
$Q_{25\%}$:	L4 = 44%	$P_{25\%}$:	5,35	1,46	Compensated	$EEI_{C20\% = 0,49}$:	0,2227

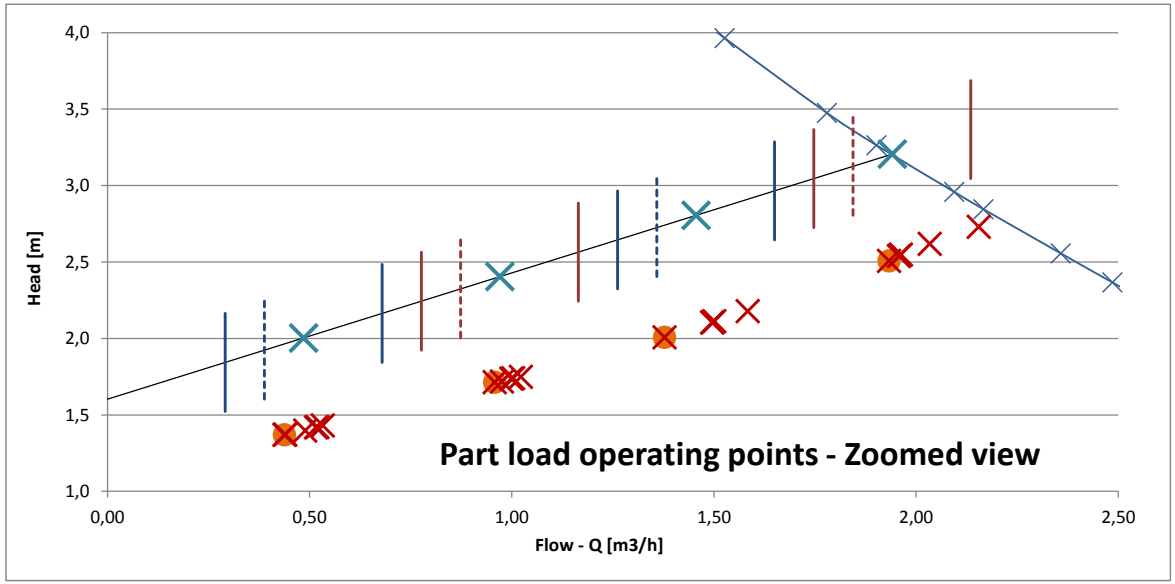
Measured values:

bar -> pascal

	Water temp.	Flow [m3/h]	p_diff - [pascal]	P1 - [Watt]
	18,7	2,16	26754,5	49,2
	18,7	1,96	24887,0	41,3
	18,7	2,03	25660,0	44,3
	18,7	1,96	24978,6	41,5
1	18,7	1,93	24570,3	40,2
	18,7	1,50	20699,3	26,6
	18,7	1,50	20626,2	26,4
2	18,7	1,38	19672,3	23,4
	18,7	1,58	21349,6	28,8
	18,7	1,50	20628,5	26,5
	18,6	1,02	17144,7	16,1
	18,6	1,00	17048,3	15,8
	18,6	0,98	16844,8	15,3
	18,6	1,00	17021,8	15,7
3	18,5	0,96	16791,1	15,1
	18,5	0,53	14025,2	9,3
	18,5	0,52	13922,9	9,1
	18,4	0,52	13902,7	9,1
	18,4	0,49	13700,6	8,8
4	18,4	0,44	13425,9	8,3
	18,4	0,44	13447,3	8,3

Calculated values:

Head [m]	Rho H_2O
2,73	998,4
2,54	998,4
2,62	998,4
2,55	998,4
2,51	998,4
2,11	998,4
2,10	998,4
2,01	998,4
2,18	998,4
2,10	998,4
1,75	998,4
1,74	998,4
1,72	998,4
1,74	998,4
1,71	998,4
1,43	998,4
1,42	998,4
1,42	998,4
1,40	998,4
1,37	998,4
1,37	998,5



Uncertainty calculation

Power analyzer, Zimmer LMG-450

The 4 applied dutypoints:				Peaks		% of Reading			% of Peak Range			Total absolute errors			Relative error		
	Volt	Amps	Power	Volt	Amps	0,1	0,15	0,2	0,1	0,1	0,1	ΔU [Volt]	ΔI [Amps]	ΔP [Watt]	%rdg	%rdg	%rdg
1	227,63	0,32	40,2	400	1,875	0,228	4,74E-04	0,080	0,400	1,88E-03	0,750	0,628	2,35E-03	0,830	0,28%	0,74%	2,07%
2	228,36	0,18	23,4	400	1,875	0,228	2,70E-04	0,047	0,400	1,88E-03	0,750	0,628	2,15E-03	0,797	0,28%	1,19%	3,40%
3	231,81	0,12	15,1	400	1,875	0,232	1,84E-04	0,030	0,400	1,88E-03	0,750	0,632	2,06E-03	0,780	0,27%	1,68%	5,17%
4	232,32	0,07	8,3	400	1,875	0,232	1,06E-04	0,017	0,400	1,88E-03	0,750	0,632	1,98E-03	0,767	0,27%	2,80%	9,21%

Differential pressure Sitrans P DS III

r = span ratio (0.0029·r + 0,071)%

Skala 0 - 500 mbar

	3 different scales:	Head [m]	r	Calc %	Calc mbar	*DTI Lab. cal.*		Pascal	Rho H_2O	g	ΔH [m]
1	0 - 500 mbar	3,21	10	0,100	0,50	*xxx*	*%*	50,0	997,3	9,816	0,0051
	0 - 1500 mbar	3,21	3,3	0,081	1,21	*xxx*	*%*	121,0	997,3	9,816	0,0124
	0 - 5000 mbar	3,21	1	0,074	3,70	*xxx*	*%*	369,5	997,3	9,816	0,0377

Flow measurement MAGFLO

Danfoss MAGFLO -> 6 m3/h

	2 different scales:	Flow [m^3/h]	Diameter	Area	Speed [m/s]	Calc [%]	Calc [m^3/h]	*DTI Lab. cal.*		ΔQ [m^3/h]
1	0 - 5 m^3/h	1,94	25,00	0,00049	1,10	0,50	0,010	*xxx*	*%*	0,010
	0 - 120 m^3/h	1,94	65,00	0,00332	0,16	1,54	0,030	*xxx*	*%*	0,030

Uncertainty calculation:

$P_{L,avg}$:	Watt	$\Delta P_{L,avg}$	**P_{hyd}:**	ΔP_{hyd}	**P_{ref}:**	ΔP_{ref}	**EEI calc:**	ΔP_{ref}
$P_{100\%,\ wieghted}$:	3,08	0,0368	$\Delta H*\delta P_{hyd}/\delta H$:	0,0489	$\delta P_{ref}/\delta P_{hyd}$:	1,732	$\Delta P_{L,avg}*\delta EEI/\delta P_{L,avg}$:	4,02E-03
$P_{75\%,\ wieghted}$:	4,91	0,0964	$\Delta Q*\delta P_{hyd}/\delta Q$:	0,0156	$\Delta P_{hyd}*\delta P_{ref}/\delta P_{hyd}$:	0,178	$\Delta P_{ref}*\delta EEI/\delta P_{ref}$:	-4,33E-04
$P_{50\%,\ wieghted}$:	7,42	0,2212	Std. deviation P_{hyd}:	0,0513	Std. deviation P_{ref}:	0,089	Std. deviation EEI:	4,05E-03
$P_{25\%,\ wieghted}$:	5,35	0,2848						

20,8	**0,75**	**3,61%**	**16,9**	**0,10**	**0,61%**	**45,7**	**0,18**	**0,39%**	**0,2227**	**± 0,0081**	**3,63%**

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