

## **Heat Recovery Systems** PTG, SWT Series





#### Why recover heat?

The question should in fact be: Why not recover heat? Amazingly, almost 100 percent of the electrical energy input to a compressor is turned into heat. Approximately 2 percent of this energy radiates away from the compressor package into the ambient surroundings and 2 percent remains in the compressed air. This means that with installation of heat recovery systems from KAESER KOMPRESSOREN up to 96 % of the energy dedicated to compressed air production can be recovered and reused. Therefore, in view of continuously soaring energy prices and concerns regarding the environment, the potential benefits and savings are enormous.

#### Benefit the environment and save costs with heat recovery



Potential energy cost Maintenance costs savings

If we examine the total costs (life cycle costs) of a compressed air system, we see that energy accounts for the lion's share. In fact energy costs still make up at least 70 percent of total costs even for optimised systems. However, a considerable proportion of these costs can be saved by using recyclable heat from the compressor via heat recovery. This not only benefits a company's annual operational budget to the tune of thousands of Euro per year, but also reduces the impact on the environment through a multi-ton reduction in CO<sub>2</sub> emissions.

# **Heat recovery**



Turn to pages 6 and 7 to see how much you could save.



Up to 96 percent of the heat generated by a rotary screw compressor can be recovered as reusable energy. Every litre of fuel oil saved equates to a 2.727 kg reduction in CO<sub>2</sub> emissions, which is not only beneficial for the environment, but also results in significant cost savings. At today's energy prices, the amortisation period for a heat recovery system ranges between 6 months and 1 year (based on a plate heat exchanger feeding energy into a heating system). Warm air can also be recovered for use from older KAESER rotary screw compressors simply by installing additional ducting. We install optional fail-safe and plate heat exchangers for new rotary screw compressor systems (from 18.5 kW and up). For older rotary screw compressor installations we offer specially designed retro-fit kits.



### Significant savings in spite of rising energy prices

The trend for continuously rising fuel oil costs has had a knock-on effect on energy prices in general. However, you can counteract this tendency by equipping your compressor installations with high performance heat recovery systems.



### Heating with warm air

Warmed compressor cooling air can be ducted away to provide highly effective space heating. With this method, up to 96% of the compressor's input energy can therefore be recovered as heat.



#### Feed heat energy to a heating system

Unbelievable as it may seem, in a fully encapsulated fluid-/oil-cooled rotary screw compressor package, up to 76% of the input energy for the compressor system can be recovered as heat. This drastically reduces the need for use of primary energy for heating purposes.

#### Heat recovery reduces costs and benefits the environment

## Heat flow diagram

Amazingly, almost 100 percent of the electrical energy input to a compressor is converted into heat.

The adjacent **heat flow diagram (right)** shows how this energy is distributed throughout the compressor system and how it can be recovered:

96 percent of the energy can be recovered for reuse, two percent remains in the compressed air and two percent radiates away from the compressor package into the ambient surroundings. So where does the usable energy in compressed air come from? The answer is actually guite simple and perhaps surprising: During the compression process and conversion of the electrical drive energy into heat, the compressor charges the air it draws in with energy potential. This corresponds to approximately 25 percent of the compressor's electrical power consumption. This energy is only usable however once the compressed air expands at its point of use and in so doing absorbs heat energy from the ambient surroundings. Of course the amount of this energy that is available for use depends on the pressure and leakage losses within the compressed air system.



## **Appropriate cooling**

The enclosed, compact design of modern rotary screw compressors makes them especially suitable for heat recovery. Direct use of the recyclable heat via a ducting system enables up to 96 % of the compressor's total energy requirement to be recovered and used for heating purposes. This is the case irrespective of whether fluid-injection cooled compressors or dry-running screw compressors are used.



Moreover, the feeding of recyclable compressor heat into hot water heating systems and industrial water systems is also well worthwhile: Over 70 percent of the installed compressor power can still be recovered for heating applications, and without the need for additional energy consumption.

Unlike fluid-cooled compressors however, dry-running rotary screw compressors must be primarily water-cooled in order to take advantage of this heat recovery method.

Usable cooling air with a rotary screw compressor



## Heat exchanger systems

Hot water – up to 70 °C, or even 90 °C if required – for various purposes can be produced either via a PTG plate heat exchanger or a SWT fail-safe heat exchanger. PTG heat exchanger systems are used for conventional water heating applications, whilst SWT fail-safe heat exchangers are recommended for applications that have no other interconnecting water circuits and where it is essential that the water being warmed remains completely uncontaminated.

#### PTG plate heat exchanger

The cost-effective solution to enable utilisation of recyclable heat from rotary screw compressors.

#### Application:

- Feeding of heat into central heating systems
- Laundries
- Electroplating
- General process heat





Heat fed to heating system

#### SWT fail-safe heat exchanger

Fail-safe plate heat exchangers prevent the possibility of water and cooling fluids from mixing.

#### Application:

- Food processing industry
- Water heating
- Chemical and pharmaceutical industry
- Cafeterias and large scale catering establishments



### Warm air heat recovery

When using recyclable heat for space heating, ducting simply feeds the warmed cooling air to where it is needed e.g. adjacent facilities, such as warehouses or workshops.

At warmer times of the year when heating is not required, a louver flap can be used to vent this warm air to the outside. Thermostatically controlled, motorised louvers are able to precisely maintain the temperature in a room by enabling partial or full flow of heating air.

Ducting installation



Ducting for heating of adjacent rooms

#### **Application:**

- Auxiliary or main heating for warehouses or workshops
- · To aid drying in painting and washing applications
- To create air curtains
- Improving efficiency of oil burners through the heating of combustion air

## **Savings in detail:**

#### Warm air heat recovery

All KAESER rotary screw compressors are designed for attachment of ducting, which is installed on-site. Neighbouring rooms and warehouse space, for example, can be heated with the warmed cooling air.

#### **PTG plate heat exchanger**

Rotary screw compressors from the SM series (from 5.5 kW) upwards can be equipped with PTG systems. Depending on the size of the compressor system, the PTG heat exchanger is either integrated within the unit or is installed externally.

#### **SWT** fail-safe heat exchanger

Rotary screw compressors from the ASD series upwards can also be equipped with SWT fail-safe heat exchanger systems. The SWT heat exchangers are always installed externally from the rotary screw compressor.



It goes without saying that heating is necessary during the winter months, but it is also required for significant periods at other times of the year, such as in spring and autumn. This means that heating energy is actually required for approximately 2000 hours per year.



#### Savings through warm air heat recovery

For rotary	Rated	Maximum		Usable volume	Amount	Pote	Potential fuel oil saving Potential natural gas s					
pressor	power	capa	acity	of heating air	air is heated	Fuel oil	CO <sub>2</sub>	Heating cost	Natural gas	CO <sub>2</sub>	Heating cost	
Model	kW	kW	MJ/h	m³/h	K (approx.)	I.	kg	€/Year	m <sup>3</sup>	kg	€/Year	
SX 3	2.2	2.8	10	1000	8	473	1290	284	400	800	280	
SX 4	3	3.6	13	1000	11	608	1658	365	514	1028	360	
SX 6	4	4.5	16	1000	14	761	2075	457	643	1286	\$10	
SX 8	5.5	6.1	22	1300	14	1031	2812	619	871	1742	\$10	
SM 9	5.5	6.8	25	2100	10	1149	3133	ential for	971	1942	680	
SM 12	7.5	9.1	33		13	1538	4194	856 1'10	1300	2600	910	
SM 15	9	11.8	43		17	1994	5438	1'100	1686	3372	1,180	
SK 21	11	12.5	45	2500	15	2113	5762	වි 1,268	1786	3572	<u>වි</u> 1,250	
SK 24	15	15.3	55	2700	17	2586	7052	සු 1,552	2186	4372	සු 1,530	
ASK 27	15	18.0	65	3000	18	3042	8296	1,825	2571	5142	1,800	
ASK 32	18.5	21.8	78	3500	19	3685	10049	2,211	3114	6228	2,180	
ASK 35	22	24.9	90	4000	19	4208	11475	2,525	3557	7114	2,490	
ASD 32	18.5	20.8	75	3800	16	4687	12781	2,812	3962	7924	2,773	
ASD 37	22	24.7	89	3800	20	5566	15178	3,340	4705	9410	3,294	
ASD 47	25	29.7	107	4500	20	6693	18252	4,016	5657	11314	3,960	
ASD 57	30	35.6	128	5400	20	8023	21879	4,814	6781	13562	4,747	
BSD 62	30	35.1	126	8000	13	7910	21571	4,746	6686	13372	4,680	
BSD 72	37	43.2	156		16	9735	26547	5,841	8229	16458	5,760	
BSD 81	45	53	191		20	11944	32571	7,166	10095	20190	7,067	
CSD 82	45	52	187	9400	17	11718	31955	7,031	9905	19810	6,934	
CSD 102	55	64	230	9400	20	14423	39332	8,654	12190	24380	8,533	
CSD 122	75	76	274	10700	21	17127	46705	10,276	14476	28952	10,133	
CSDX 137	75	87	313	13000	20	19606	53466	<u>دہ</u> 11,764	16571	33142	و <u>ہ</u> 11,600	
CSDX 162	90	103	371		24	23212	63299	13,927	19619	39238	13,733	
DSD 142 DSD 172 DSD 202 DSD 238	75 90 110 132	84 98 124 151	302 353 446 544	9000 14000 14000 21000	28 21 27 22	18930 22085 27944 34029	51622 60226 76203 92797	20 11,358 13,251 16,766 20,417	16000 18667 23619 28762	32000 37334 47238 57524	20,11,200 13,067 16,533 20,133	
DSDX 243	132	149	536	21000	21	33578	91567	20,147	28381	56762	od 19,867	
DSDX 302	160	180	648		26	40564	110618	se 24,338,-	34286	68572	ເຊິ້ 24,000	
ESD 251 ESD 301 ESD 351 ESD 361 ESD 441	132 160 200 200 250	140 182 225 214 247	504 655 810 770 889	21000 23000 27000 27000 34000	20 24 25 24 22	31550 41015 50705 48226 55663	86037 111848 138273 131512 151793	5 18,930 24,609 30,423 28,936 33,398	26667 34667 42857 40762 47048	53334 69334 85714 81524 94096	5 18,667 24,267 30,000 28,533 32,934	
FSD 471	250	282	1015	40000	21	63550	173301	38,130	53714	107428	37,600	
FSD 571	315	342	1231		26	77071	210173	46,243	65143	130286	45,600	
HSD 651	360	35	127	10000	11	7932	21631	4,759	6705	13410	4,694	
HSD 711	400	38	138		11	8609	23477	5,165	7276	14552	5,093	
HSD 761	450	42	151		13	9465	25811	5,679	8000	16000	5,600	
HSD 831	500	46	164		14	10276	28023	6,166	8686	17372	6,080	

#### Savings with PTG plate heat exchanger system

For	Rated	Maxi	mum	Heated water volume		Installation	Potential fuel oil saving Potential natural ga					is saving		
compressor	power	heat capacity				system	Fuel oil	CO <sub>2</sub>	Heating cos	Natural gas		Heat	ing cost	
Model	kW	kW	MJ/h	(ΔT 25 °C) m³/h	(ΔT 55 °C) m³/h	Int./Ext.	I	kg	saving €/Year	m³	kg	sa €/	€/Year	
SM 9 SM 12 SM 15	5.5 7.5 9	4.6 6.2 8.3	17 22 30	0.16 0.21 0.29	0.07 0.10 0.13	External	777 1048 1403	2119 2858 3826	466 629 842	657 886 1186	1314 1772 2372		460 620 830	
SK 21 SK 24	11 15	8.8 11.0	32 40	0.30 0.38	0.14 0.17	External	1487 1859	4055 5069	SH 892	1257 1571	2514 3142	500 hrs	880 1,100	
ASK 27 ASK 32 ASK 35	15 18.5 22	13.0 15.8 17.8	47 57 64	0.45 0.54 0.61	0.20 0.25 0.28	External	2197 2670 3008	5991 7281 8203	1,318 1,602 1,805	1857 2257 2543	3714 4514 5086	ential for 18	1,300 1,580 1,780	
ASV 40 ASV 60	7.5 11	4.3 6.5	16 23	0.15 0.22	0.07 0.10	External	727 1099	1983 2997	436 551 559	614 929	1228 1858	ngs pot	430 650	
BSV 80 BSV 100	15 18.5	9.4 11.7	34 42	0.32 0.40	0.15 0.18	External	1589 1977	4333 5391	953 953 1,186	1343 1671	2686 3342	Savi	940 1,170	
CSV 125 CSV 150	22 30	12.4 16.5	45 59	0.43 0.57	0.19 0.26	External	2096 2789	5716 7606	1,258 1,673	1771 2357	3542 4714		1,240 1,650	

#### **Savings with PTG and SWT heat exchanger systems**

For	Rated	Maximum	mum Heated w		ater volume	Installation of the PTG system	Installation of the SWT system	Potential fuel oil saving Potential natural gas sa					as sav	/ing
compress	sor power	heat c	apacity					Fuel oil	CO₂ reduction	Heating cost	Natural gas	CO <sub>2</sub> reduction	Hea	ting cost aving
Model	kW	kW	MJ/h	(Δ1 25 °C) m³/h	(Δ1 55 °C) m³/h	Int./Ext.	Int./Ext.	1	kg	€/Year	m³	kg	•	/Year
ASD 32 ASD 37 ASD 47 ASD 57	18.5 22 25 30	15.8 18.6 22.6 27.4	57 67 81 99	0.54 0.64 0.78 0.94	0.25 0.29 0.35 0.43	Internal External 33561 9711 4192 11432 5093 13889 6175 16839		9711 11432 13889 16839	2,137 2,515 3,056 3,705	3010 3543 4305 5219	6020 7086 8610 10438		2,107 2,480 3,014 3,653	
BSD 62 BSD 72 BSD 81	30 37 45	26.8 33.1 40.9	96 119 147	0.92 1.14 1.41	0.42 0.52 0.64	Internal	External	6040 7459 9217	16471 20341 25135	3,624 4,475 5,530	5105 6305 7790	10210 12610 15580		3,574 4,414 5,453
CSD 82 CSD 102 CSD 122	45 55 75	40.3 49.4 58	145 178 209	1.39 1.70 2.00	0.63 0.77 0.91	Internal	External	9082 11133 13071	24767 30360 35645	5,449 6,680 7,843	7676 9410 11048	15352 18820 22096		5,373 6,587 7,734
CSDX 13 CSDX 16	<b>37</b> 75 <b>52</b> 90	67 80	241 288	2.30 2.80	1.05 1.25	Internal	External	15099 18028	41175 49162	외 9,059 또 10,817	12762 15238	25524 30476	0 hrs	8,933 10,667
DSD 142 DSD 172 DSD 202 DSD 238	75 90 110 132	66 76 97 119	238 274 349 428	2.30 2.60 3.30 4.10	1.03 1.19 1.52 1.86	Internal	External	14873 17127 21859 26817	40559 46705 59609 73130	8,924 10,276 13,115 16,090 15,820 19,336	12571 14476 18476 22667	25142 28952 36952 45334	tential for 200	8,800 10,133 12,933 15,867
DSDX 24 DSDX 30	<b>13</b> 132 <b>16</b> 0	117 143	421 515	4.00 4.90	1.83 2.24	Internal	External	26366 32226	71900 87880		22286 27238	44572 54476	tod sbui	15,600 19,067
ESD 251 ESD 301 ESD 351 ESD 361 ESD 441	132 160 200 200 250	110 142 178 169 194	396 511 641 608 698	3.80 4.90 6.10 5.80 6.70	1.72 2.22 2.79 2.65 3.04	Internal	External	24789 32000 40113 38085 43719	67600 87264 109388 103858 119222	22,851 26,231	20952 27048 33905 32190 36952	41904 54096 67810 64380 73904	Sav	14,666 18,934 23,734 22,533 25,866
FSD 471 FSD 571	250 315	218 266	785 958	7.50 9.20	3.41 4.17	Internal	External	49127 59944	133969 163467	29,476 35,966	41524 50667	83048 101334		29,067 35,467
HSD 651 HSD 711 HSD 761 HSD 831	360 400 450 500	313 339 372 405	1127 1220 1339 1458	10.80 11.70 12.80 14.00	4.90 5.31 5.83 6.34	Internal	External	70536 76395 83832 91269	192352 208329 228610 248891	42,322 45,837 50,299 54,761	59619 64571 70857 77143	119238 129142 141714 154286		41,733 45,200 49,600 54,000

#### **Calculation example for ASD 32**

#### For fuel oil

Maximum available h Fuel value per litre of Fuel oil heating effici Price per litre of fuel	neat capacity f heating oil: ency: oil:	15.8 kW 9.861 kWh/l 0.9 0.60 €/l	1 kW = 1 MJ/h x 3.6
Cost saving:	15.8 kW x 2000	<u>h</u> /I x 0.60 €/I	= € 2,137

# COMPRESSORS

#### For natural gas

Maximum available hea	t capacity	15.8 kW				
Fuel value per m <sup>3</sup> natura	al gas:	10 kWh/m³				
Natural gas heating effic	siency:	1.05				
Price per m <sup>3</sup> of natural g	jas:	0.70 €/m³ 1 kW = 1 MJ/h x 3.6				
Cost saving:	15.8 kW x 200	<u>0h</u> /m³ x 0.70 €	/m³ = <b>€ 2,107</b>			



## **KAESER** – The world is our home

As one of the world's largest manufacturers of rotary screw compressors, KAESER KOMPRESSOREN is represented throughout the world by a comprehensive network of branches, subsidiary companies and authorised partners in over 90 countries.

With innovative products and services, KAESER KOMPRESSOREN's experienced consultants and engineers help customers to enhance their competitive edge by working in close partnership to develop progressive system concepts that continuously push the boundaries of performance and compressed air efficiency. Moreover, the decades of knowledge and expertise from this industry-leading system provider are made available to each and every customer via the Kaeser group's global computer network.

These advantages, coupled with KAESER's worldwide service organisation, ensure that all products operate at the peak of their performance at all times and provide maximum availability.





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