KAESER COMPRESSORS®

Heat Recovery Systems

For hot air and hot water applications

www.kaeser.com

Why choose heat recovery?

In fact, the question should be: Why not? Amazingly, virtually 100% of the electrical energy supplied to a rotary screw compressor is converted into heat energy.

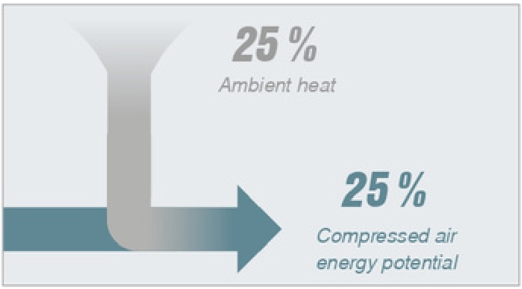
Up to 96% of this energy can be recovered and reused for heating purposes. This not only reduces primary energy consumption, but also significantly improves a company's overall energy balance.

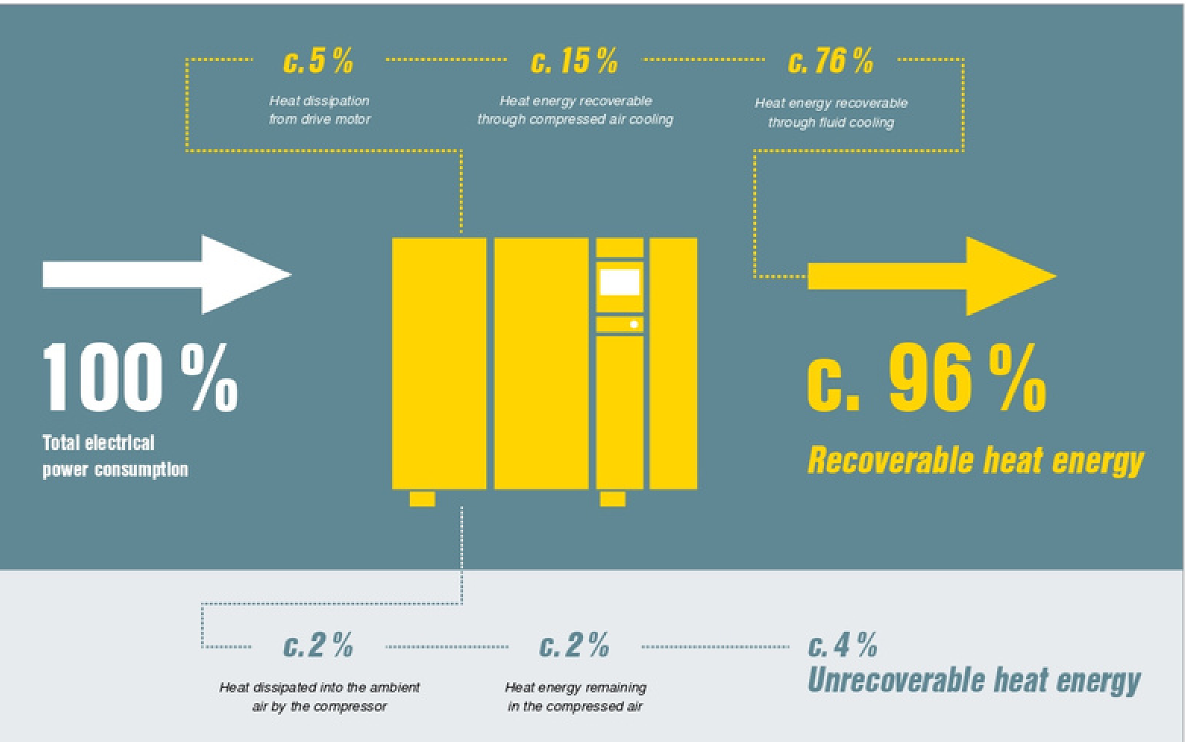
Compressor heat

Rotary screw compressors, boosters and blowers convert almost 100% of the electrical drive energy supplied to them into heat. The heat flow diagram (below) shows how this energy is distributed within the compressor system and how much of it is reusable.

Approximately 96% of the energy input can be recovered for reuse, whilst 2% remains in the compressed air and another 2% is dissipated into the ambient surroundings. But where does the usable energy in compressed air come from?

The answer is actually quite simple and perhaps surprising: during the compression process, the compressor converts electrical drive energy into heat energy. At the same time, it charges the intake air with energy potential. This corresponds to approximately 25% of the compressor's electrical power consumption. However, this energy only becomes usable when the compressed air expands again at its point of consumption and, in doing so, absorbs heat energy from the ambient surroundings. Of course, the amount of energy available for reuse depends on the pressure and leakage losses within the compressed air system.





Save money whilst conserving the environment

Savings

Gas heating
€ 302 to € 83,810/year

Oil heating
€ 304 to € 84,283/year

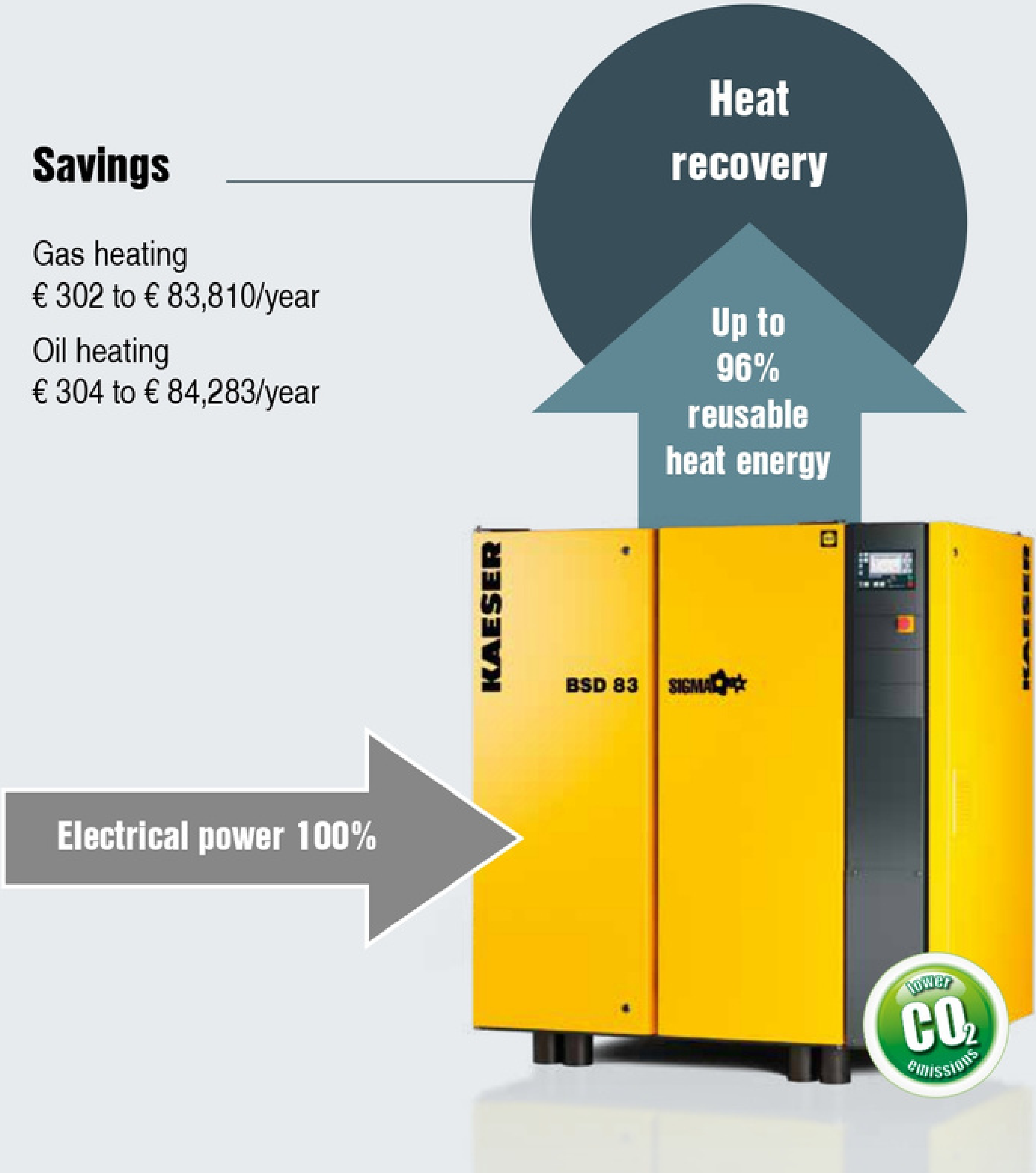


Plate-type heat exchanger systems	Compressor size		
	"Small"	"Medium"	"Large"
Compressor model	SM 16	BSD 83	FSD 475
Drive motor rated power	9 kW	45 kW	250 kW
Potential savings per year: Heating oil	€ 857	€ 9,037	€ 45,522
	4671 kg CO_2	49,285 kg CO_2	248,274 kg CO_2

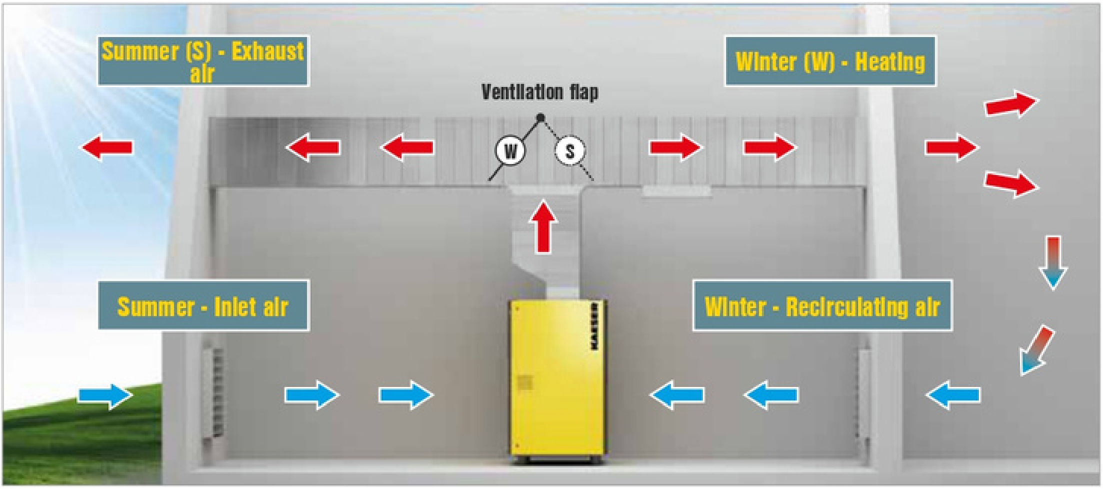
Image: DN 45 C booster with hot air heat recovery

Minimise primary energy consumption for heating

As self-contained complete systems, modern rotary screw compressors, boosters and blowers are especially well suited for heat recovery systems.

In particular, direct usage of the recoverable heat via an exhaust air ducting system enables up to 96% of the total energy input to be recovered and reused.

This is the case regardless of whether a fluid-injecting or a dry-running rotary screw compressor, a booster or a blower is involved.



Heating with hot air

By using heated cooling air from the compressor, neighbouring spaces can be heated simply and effectively via exhaust air ducting. In this way, up to 96% of the electrical power supplied to a compressor can be reused – either for the purposes of space heating or for use as process heat. When using recovered compressor exhaust heat for space heating purposes, exhaust air ducting simply feeds the heated cooling air to wherever it is needed, thereby allowing such spaces as storage areas or workshops to be heated free of charge. A ventilation flap allows the heated cooling air to be conveyed outside during summer operation (S) or to the areas that require heating during winter operation (W).

Minimise primary energy consumption for process, service and hot water heating

By reusing the exhaust heat from the compressor, heat exchanger systems can provide heating and service water on demand at temperatures up to +70 °C, or even +85 °C if required.

For standard applications using heat recovery systems for the production of hot water and service water, PTG plate-type heat exchangers are used.

Special, fail-safe heat exchangers are used in the case of operations without an interconnected water circuit, or for applications with the highest demands of purity for the heated water, such as with cleaning water in the food industry.

Hot water with temperatures up to +70 °C can easily be produced using a heat exchanger system, with even higher temperatures available upon request.

Use heat energy for your heating systems

Up to 76% of the electrical power originally supplied to a compressor can be recovered for use in hot water heating systems and service water installations. This significantly reduces the amount of primary energy required for heating purposes.

PTG plate-type heat exchanger

High-quality, stainless steel plate-type heat exchangers are the first choice when it comes to using heat recovered from rotary screw compressors for heating process and service water, or for generating process heat.


2
3
4
5


Equipment for rotary screw compressors

Hot air heat recovery

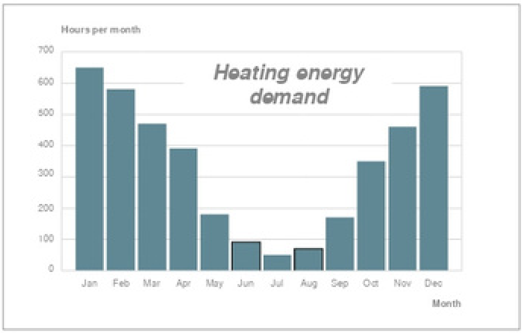
All KAESER rotary screw compressors can be connected to user-end exhaust air ducting, allowing the heated cooling air to be used for the purposes of space heating. Possible applications include drying processes, heating of halls and buildings, air curtain systems and the preheating of burner air.

PTG plate-type heat exchanger system

Rotary screw compressors from the SM series (from 5.5 kW) and upwards can be equipped with PTG systems. Depending on the size of the system, the PTG heat exchanger can either be integrated into the compressor or installed externally. Possible areas of application: Supplying heat for central heating systems, laundry facilities, electroplating, general process heat.
With special, fail-safe heat exchangers: Cleaning water in the food industry, swimming pool heating, hot water for shower and washroom facilities.

Shell and tube heat exchanger

For cases where the cooling water quality is inadequate (e.g. hard, contaminated cooling water or seawater with high salt content), special shell and tube heat exchangers are optionally available. Our compressed air specialists can advise you regarding the right design for your particular application.



Heating – not just needed in winter

It goes without saying that heating is necessary during the winter months. However, it is also required to a greater or lesser extent throughout the year, e.g. for supplying hot water. This means that the energy demand for heating is actually approximately 4000 hours per year.

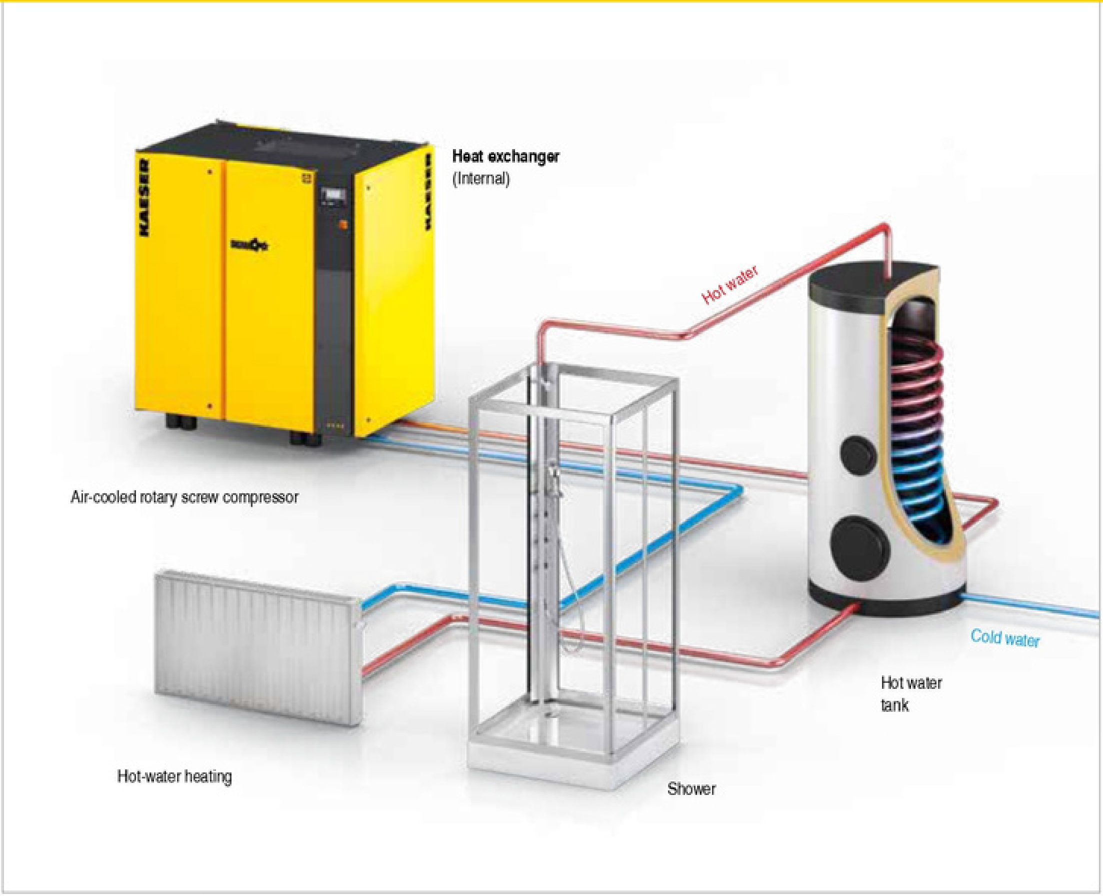


Image: Heat recovery process. Potable water applications only possible in conjunction with special, safety heat exchanger

Image: Internal layout of a compressor – system comprising plate-type heat exchanger, thermostatic valve and complete piping

Technical specifications for...

Hot air

Type	At max. gauge pressure	Rated motor power	Maximum available heating capacity		Usable hot air volume	Cooling air heated by	Potential fuel oil savings			Potential natural gas savings		
							Fuel oil	CO_2	Heating cost savings	Natural gas	CO_2	Heating cost savings
	bar	kW	kW	MJ/h [1]	m³/h	K (approx.)	l	kg	€/year	m³	kg	€/year
Savings potential for 2000 hrs/yr												
SX 3	8	2.2	2.7	10	1000	8	608	1658	304	504	1008	302
SX 4		3	3.4	12	1000	10	766	2089	383	635	1270	381
SX 6		4	4.4	16	1000	13	992	2705	496	822	1644	493
SX 8		5.5	6.0	22	1300	14	1352	3687	676	1120	2240	672
SM 10	8	5.5	6.8	25	2100	10	1532	4178	766	1270	2540	762
SM 13		7.5	9.1	33		13	2051	5593	1,026	1699	3398	1,019
SM 16		9	11.1	40		16	2501	6820	1,251	2073	4146	1,244
SK 22	8	11	13.2	48	2500	16	2975	8113	1,488	2465	4930	1,479
SK 25		15	16.5	59	3000	17	3718	10,139	1,859	3081	6162	1,849
ASK 28	8	15	18.4	66	4000	14	4147	11,309	2,074	3436	6872	2,062
ASK 34		18.5	22.8	82	4000	17	5138	14,011	2,569	4258	8516	2,555
ASK 40		22	26.8	96	5000	16	6040	16,471	3,020	5005	10,010	3,003
Savings potential for 4000 hrs/yr												
ASD 35	8.5	18.5	19.9	72	3800	16	8969	24,458	4,485	7432	14,864	4,459
ASD 40		22	23.5	85	3800	19	10,592	28,884	5,296	8777	17,554	5,266
ASD 50		25	28.0	101	4500	19	12,620	34,415	6,310	10,458	20,916	6,275
ASD 60		30	34.6	125	5400	19	15,595	42,528	7,798	12,923	25,846	7,754
BSD 65	8.5	30	35.2	127	6500	16	15,865	43,264	7,933	13,147	26,294	7,888
BSD 75		37	43.4	156	8000	16	19,561	53,343	9,781	16,209	32,418	9,725
BSD 83		45	52.0	187	8000	20	23,437	63,913	11,719	19,421	38,842	11,653
CSD 85	8.5	45	50	179	9400	16	22,445	61,208	11,223	18,599	37,198	11,159
CSD 105		55	62	223	9400	20	27,944	76,203	13,972	23,156	46,312	13,894
CSD 125		75	75	270	10,700	21	33,803	92,181	16,902	28,011	56,022	16,807
CSDX 140	8.5	75	84	302	11,000	23	37,860	103,244	18,930	31,373	62,746	18,824
CSDX 165		90	101	364	13,000	23	45,522	124,138	22,761	37,722	75,444	22,633
DSD 145	9	75	82	295	11,000	22	36,958	100,784	18,479	30,626	61,252	18,376
DSD 175	8.5	90	96	346	13,000	22	43,268	117,992	21,634	35,854	71,708	21,512
DSD 205	8.5	110	120	432	17,000	21	54,085	147,490	27,043	44,818	89,636	26,891
DSD 240	8.5	132	145	522	20,000	22	65,353	178,218	32,677	54,155	108,310	32,493
DSDX 245	8.5	132	143	515	21,000	20	64,451	175,758	32,226	53,408	106,816	32,045
DSDX 305		160	174	626		25	78,423	213,860	39,212	64,986	129,972	38,992
ESD 375	8.5	200	221	796	30,000	22	99,607	271,628	49,804	82,540	165,080	49,524
ESD 445		250	254	914	34,000	22	114,480	312,187	57,240	94,865	189,730	56,919
FSD 475	8.5	250	274	986	40,000	21	123,494	336,768	61,747	102,334	204,668	61,400
FSD 575		315	333	1199		25	150,086	409,285	75,043	124,370	248,740	74,622
HSD 662	8.5	360	21	76	10,000	6	9465	25,811	4,733	7843	15,686	4,706
HSD 722		400	24	86		7	10,817	29,498	5,409	8964	17,928	5,378
HSD 782		450	25	90		7	11,268	30,728	5,634	9337	18,674	5,602
HSD 842		500	28	101		8	12,620	34,415	6,310	10,458	20,916	6,275

[1] 1 MJ/h = 1 kW x 3.6

Savings calculation example for ASD 50

For fuel oil

Maximum available heating capacity:	28.0 kW
Calorific value per litre of fuel oil:	9861 kWh/l
Fuel oil heating efficiency:	90 %
Price per litre of fuel oil:	€ 0.50/l

Cost savings: $\frac{28.0\ \text{kW} \times 4000\ \text{hrs/yr}}{0.90 \times 9861\ \text{kWh/l}} \times € 0.50/\text{l}$ **= € 6,310 per year**

For natural gas

Maximum available heating capacity:	28.0 kW
Calorific value per m³ natural gas:	10.2 kWh/m³
Natural gas heating efficiency:	105 %
Price per m³ of natural gas:	€ 0.60 /m³

Cost savings: $\frac{28.0\ \text{kW} \times 4000\ \text{hrs/yr}}{1.05 \times 10.2\ \text{kWh/m}^3} \times 0.60\ €/\text{m}^3$ **= € 6,275 per year**

Note: The potential energy savings indicated are based on compressors at operating temperature and max. gauge pressure (8.0 / 8.5 / 9.0 bar). At other pressures, values may vary.

...rotary screw compressors

Hot water

Type	At max. gauge pressure	Rated motor power	Maximum available heating capacity		Hot water volume (heating to 70 °C)		PTG system location	Potential fuel oil savings			Potential natural gas savings		
								Fuel oil	CO_2	Heating cost savings	Natural gas	CO_2	Heating cost savings
	bar	kW	kW	MJ/h [*]	(ΔT 25 K) m³/h	(ΔT 55 K) m³/h	Int./ext.	l	kg	€/year	m³	kg	€/year
										Savings potential for 2000 hrs/yr			Savings potential for 2000 hrs/yr
SM 10	8	5.5	4.5	16	0.16	0.07	External	1014	2765	507	840	1680	504
SM 13	8	7.5	6.2	22	0.21	0.10	External	1397	3810	699	1158	2316	695
SM 16	8	9	7.6	27	0.29	0.13	External	1713	4671	857	1419	2838	851
SK 22	8	11	9.4	34	0.32	0.15	External	2118	5776	1,059	1755	3510	1,053
SK 25	8	15	12.0	43	0.41	0.19	External	2704	7374	1,352	2241	4482	1,345
ASK 28	8	15	13.6	49	0.47	0.21	Internal	3065	8358	1,533	2540	5080	1,524
ASK 34	8	18.5	16.9	61	0.58	0.26	Internal	3808	10,384	1,904	3156	6312	1,894
ASK 40	8	22	19.8	71	0.68	0.31	Internal	4462	12,168	2,231	3697	7394	2,218
										Savings potential for 4000 hrs/yr			Savings potential for 4000 hrs/yr
ASD 35	8.5	18.5	15.2	55	0.52	0.24	Internal	6851	18,683	3,426	5677	11,354	3,406
ASD 40	8.5	22	18.1	65	0.62	0.28	Internal	8158	22,247	4,079	6760	13,520	4,056
ASD 50	8.5	25	21.6	78	0.74	0.34	Internal	9735	26,547	4,868	8067	16,134	4,840
ASD 60	8.5	30	26.6	96	0.92	0.42	Internal	11,989	32,694	5,995	9935	19,870	5,961
BSD 65	8.5	30	27.1	98	0.93	0.42	Internal	12,214	33,308	6,107	10,121	20,242	6,073
BSD 75	8.5	37	33.5	121	1.15	0.52	Internal	15,099	41,175	7,550	12,512	25,024	7,507
BSD 83	8.5	45	40.1	144	1.38	0.63	Internal	18,073	49,285	9,037	14,977	29,954	8,986
CSD 85	8.5	45	38.6	139	1.33	0.60	Internal	17,397	47,442	8,699	14,416	28,832	8,650
CSD 105	8.5	55	48.4	174	1.67	0.76	Internal	21,814	59,487	10,907	18,077	36,154	10,846
CSD 125	8.5	75	58.6	211	2.02	0.92	Internal	26,412	72,026	13,206	21,886	43,772	13,132
CSDX 140	8.5	75	66	238	2.30	1.03	Internal	29,747	81,120	14,874	24,650	49,300	14,790
CSDX 165	8.5	90	80	288	2.80	1.25	Internal	36,057	98,327	18,029	29,879	59,758	17,927
DSD 145	9	75	61	220	2.10	0.96	Internal	27,493	74,973	13,747	22,782	45,564	13,669
DSD 175	8.5	90	71	256	2.40	1.11	Internal	32,000	87,264	16,000	26,517	53,034	15,910
DSD 205	8.5	110	88	317	3.00	1.38	Internal	39,662	108,158	19,831	32,866	65,732	19,720
DSD 240	8.5	132	107	385	3.70	1.68	Internal	48,226	131,512	24,113	39,963	79,926	23,978
DSDX 245	8.5	132	105	378	3.60	1.64	Internal	47,324	129,053	23,662	39,216	78,432	23,530
DSDX 305	8.5	160	129	464	4.40	2.04	Internal	58,142	158,553	29,071	48,179	96,358	28,907
ESD 375	8.5	200	162	583	5.60	2.54	Internal	73,015	199,112	36,508	60,504	121,008	36,302
ESD 445	8.5	250	187	673	6.40	2.93	Internal	84,283	229,840	42,142	69,841	139,682	41,905
FSD 475	8.5	250	202	727	7.00	3.16	Internal	91,043	248,274	45,522	75,444	150,888	45,266
FSD 575	8.5	315	246	886	8.50	3.85	Internal	110,874	302,353	55,437	91,877	183,754	55,126
HSD 662	8.5	360	291	1048	10.00	4.56	Internal	131,156	357,662	65,578	108,683	217,366	65,210
HSD 722	8.5	400	323	1163	11.10	5.06	Internal	145,579	396,994	72,790	120,635	241,270	72,381
HSD 782	8.5	450	348	1253	12.00	5.45	Internal	156,847	427,722	78,424	129,972	259,944	77,983
HSD 842	8.5	500	374	1346	12.90	5.86	Internal	168,565	459,677	84,283	139,683	279,366	83,810

[*] 1 MJ/h = 1 kW x 3.6

Savings calculation example for ASD 50

For fuel oil

Maximum available heating capacity:	21.6 kW
Calorific value per litre of fuel oil:	9861 kWh/l
Fuel oil heating efficiency:	90 %
Price per litre of fuel oil:	€ 0.50/l

Cost savings: $\frac{21.6\ \text{kW} \times 4000\ \text{hrs/yr}}{0.9 \times 9861\ \text{kWh/l}} \times € 0.50/\text{l}$ **= € 4,868 per year**

For natural gas

Maximum available heating capacity:	21.6 kW
Calorific value per m³ natural gas:	10.2 kWh/m³
Natural gas heating efficiency:	105 %
Price per m³ of natural gas:	€ 0.60 /m³

Cost savings: $\frac{21.6\ \text{kW} \times 4000\ \text{hrs/yr}}{1.05 \times 10.2\ \text{kWh/m}^3} \times 0.60\ €/\text{m}^3$ **= € 4,840 per year**

Note: The potential energy savings indicated are based on compressors at operating temperature and max. gauge pressure (8.0 / 8.5 / 9.0 bar). At other pressures, values may vary.

Heat recovery systems for...

Hot air

The Air-Cooled Aftercooler (ACA) is an air/air heat exchanger. Process air is cooled in a cross-flow process, whereby ambient air is heated via a thermal energy exchange. In terms of a medium supply, only an electrical connection for the fan is needed. At an ambient temperature of +20 °C, for example, the process air flowing into the cooler can be cooled down from +150 °C to +30 °C. The ACA offers particular advantages when it comes to the pneumatic conveying of temperature-sensitive bulk materials. Furthermore, should a production hall need to be heated during the winter, the ACA can do that as well. The exhaust air flow from the cooler contains up to 75% of the electrical power in the form of blower heat. To maximise the energy gain and ensure optimum cooling efficiency, the maximum pressure loss is no more than 35 mbar. An integrated thermostat monitors operation of the unit by detecting the process air discharge temperature and activates a floating contact by means of an adjustable trigger point.

Application examples

- Cooling of process air from blowers, e.g. for bulk materials conveying
- Space heating for production halls

Hot water

The water-cooled WRN aftercooler is a shell and tube heat exchanger. With this system, the process air passes through multiple cooling pipes, around which water flows. The water serves as both a cooling and a heat transfer medium. This type of heat exchanger is individually customised for each project, so as to ensure that the drop in process air temperature and the increase in water temperature match the operator's requirements precisely. In order to minimise pressure loss resulting from the additional power consumption of the blower and to achieve maximum heat transfer, a variety of cooling pipe geometries are used. Furthermore, several different materials can be used for the cooling pipes, depending on the quality of the water supply. The cooler shrouding is enamel coated. The maximum achievable water temperature for the return flow is approx. 5 K below the process air inlet temperature inside the heat exchanger.

Application examples

- Integration into heating circuits to raise return air temperature
- Integration into heat pump circuits
- Floor heating
- Sludge drying

...blowers

Image: DC 236 C with ACA compressed air aftercooler

Image: FBS 660 S SFC with shell and tube heat exchanger

Technical specifications: Heat recovery systems...

Hot air

Model	Max. process air flow rate Nm³/min	Max. pressure loss mbar	Max. fan flow rate [1] m³/h	Fan power supply (400V) A	Fan power [1] W	Total mass kg	Dimensions W x D x H mm	Connection nominal width DN
ACA 53	5	15	1700	0.24	110	58	980 x 650 x 610	50
ACA 88	7	25	1700	0.24	110	58	980 x 650 x 610	65
ACA 130	12	25	3100	0.43	210	97	980 x 650 x 610	80
ACA 165	14	30	3100	0.43	210	97	980 x 650 x 610	100
ACA 235	22	30	6200	0.43 (2x)	210	193	1900 x 850 x 1200	100
ACA 350	30	35	6200	0.43 (2x)	210	199	1900 x 850 x 1280	150

[1] at max. compression

Savings calculation example for ACA 350 (production hall heating)

Blower (37 kW)	
Flow rate:	30 m³/min
Pressure differential:	600 mbar
Inlet temperature:	0 °C
Discharge temperature:	+52 °C

ACA 350	
Heat output:	25 kW
Air heating capacity:	2200 m³/h from 0 to +35 °C
Process air pressure loss:	35 mbar = 2.2 kW

Cost savings approx. € 5,600 per year*

* Calculation as per rotary screw compressors

...for blowers

Hot water

Model	Nominal width	V max (air)	V max (H_2O)	Connection dimensions		Dimensions		Weight
		Nm³/min	m³/h	Air	Water	∅ Shrouding	Length *)	kg
WRN 50 smooth	125	15	1	DN 125, PN 16	1 ¼	168	1410	71
WRN 90 smooth	200	30	1.5	DN 200, PN 16	1 ¼	245	1430	145
WRN 130 smooth	250	42	2	DN 250, PN 10	1 ½	273	1441	225
WRN 170 smooth	300	57	2.5	DN 300, PN 10	2	324	1441	280
WRN 250 smooth	350	75	3	DN 350, PN 10	DN 65, PN 16	375	1641	400
WRN 350 smooth	450	108	3.5	DN 450, PN 10	DN 80, PN 16	450	1649	590
WRN 450 smooth	500	145	4.5	DN 500, PN 10	DN 100, PN 16	519	1655	690

*) With welded counterflange (included in scope of delivery)

Savings calculation example for WRN 170 (supplementary heating)

Blower (37 kW)	
Flow rate:	30 m³/min
Pressure differential:	600 mbar
Inlet temperature:	0 °C
Discharge temperature:	+52 °C

WRN 170	
Heat output:	14 kW
Water heating capacity:	600 l/h water from +25 °C to +45 °C
Process air pressure loss:	20 mbar = 2 kW (approx. 1.2 kW more at blower)

Cost savings approx. € 3,150 per year*

* Calculation as per rotary screw compressors

The world is our home

As one of the world's largest manufacturers of compressors, blowers and compressed air systems, KAESER KOMPRESSOREN is represented throughout the world by a comprehensive network of branches, subsidiaries and authorised distribution partners in over 140 countries.

By offering innovative, efficient and reliable products and services, KAESER KOMPRESSOREN's experienced consultants and engineers work in close partnership with customers to enhance their competitive edge and to develop progressive system concepts that continuously push the boundaries of performance and technology. Moreover, decades of knowledge and expertise from this industry-leading systems provider are made available to each and every customer via the KAESER group's advanced global IT network.

These advantages, coupled with KAESER's worldwide service organisation, ensure that every product operates at peak performance at all times, whilst providing maximum availability.

LGA InterCert
Certified
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