How to save energy

with SCR screw compressors

Sino-Japanese joint venture
for the production of efficient compressors

SCR - compressors for the 21st century

Shanghai Screw Compressor Co., Ltd (SCR) is a manufacturing company established in 2000, focusing on innovation, research, development, production, sales and service in the field of industrial compressors. The SCR production plant is a modern facility with more than 250 employees on an area of over 80,000 m^2. More than 10% of the staff is in the engineering division with a focus on research and development.

SCR's product portfolio consists of energy-efficient screw compressors, including oil-free and two-stage solutions. SCR manufactures in accordance with ISO 9001 standards, holds CE certification for the European market, UL for the US market, Class Zero certification for oil-free machines and the performance of all machines manufactured is audited by SGS.

After more than 20 years of development, SCR has entered into strategic collaborations with many partners and its products are exported to more than 80 countries worldwide.

In 2018, SCR started a strategic cooperation in the form of a joint venture with Japanese manufacturer Anest Iwata, which implemented its quality and technology control system at SCR, helping to develop and bring new, energy-efficient solutions and even more reliable compressors to the market.

80,000
square meters of production area

83
countries with a commercial presence

50,000
compressor users

140,000
units of compressors manufactured since 2000

How much does electricity cost?

It is well known that compressors for compressed air production in the craft, industrial and energetical sectors are among the machines with the highest power consumption ever. The current situation on the energy market, when we are registering extreme price increases, should make every compressor user think whether it is not worth investing now in improving the efficiency of compressed air production and purchasing new and more efficient compressors, thus ensuring not only cost savings, but also the competitiveness of their company and eliminating price increases of their products.

Before we look together at how SCR compressors can contribute to solve your electricity bill worries, it is first of all necessary to know how much 1 kWh of electricity costs and the annual volume of energy consumption and to deduce what the potential for savings is.

Until 2021, the aggregate price of electricity including transmission was usually around 0,10 €/kWh in industry. At the end of 2021, however, it will reach approximately 0,14 - 0,16 €/kWh, which means a steep growth of 60% with further growth expected in the following years.

Power electricity price development

Annual electricity costs

The table below shows the annual costs in EUR for different appliance power, types of operation and electricity prices.

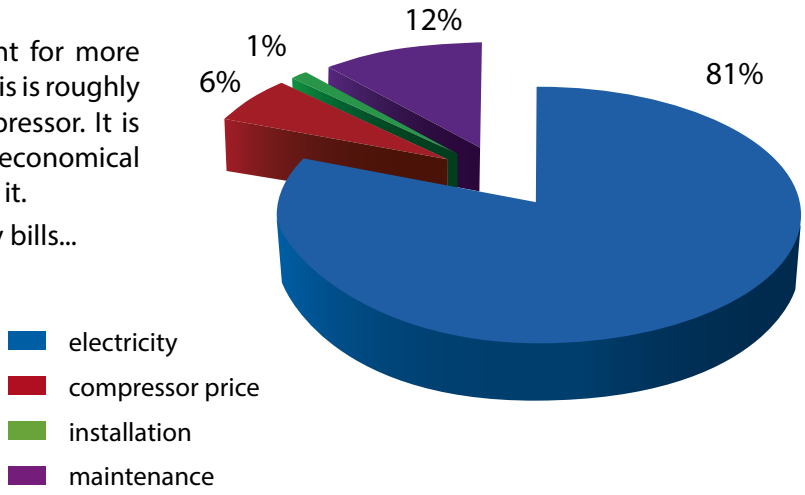
Operation	1-shift			2-shift			3-shift		
	2000 MH			4000 MH			6000 MH		
Price €/kWh	0,12	0,16	0,20	0,12	0,16	0,20	0,12	0,16	0,20
7,5 kW	1 800 €	2 400 €	3 000 €	3 600 €	4 800 €	5 900 €	5 300 €	7 100 €	8 900 €
11 kW	2 600 €	3 500 €	4 400 €	5 200 €	7 000 €	8 700 €	7 800 €	10 400 €	13 000 €
15 kW	3 600 €	4 800 €	5 900 €	7 100 €	9 500 €	11 800 €	10 600 €	14 200 €	17 700 €
18,5 kW	4 400 €	5 900 €	7 300 €	8 800 €	11 700 €	14 600 €	13 100 €	17 500 €	21 800 €
22 kW	5 200 €	7 000 €	8 700 €	10 400 €	13 900 €	17 300 €	15 600 €	20 800 €	25 900 €
30 kW	7 100 €	9 500 €	11 800 €	14 200 €	18 900 €	23 600 €	21 200 €	28 300 €	35 300 €
37 kW	8 800 €	11 700 €	14 600 €	17 500 €	23 300 €	29 100 €	26 200 €	34 900 €	43 600 €
45 kW	10 600 €	14 200 €	17 700 €	21 200 €	28 300 €	35 300 €	31 800 €	42 400 €	53 000 €
55 kW	13 000 €	17 300 €	21 600 €	25 900 €	34 600 €	43 200 €	38 900 €	51 800 €	64 800 €
75 kW	17 700 €	23 600 €	29 500 €	35 300 €	47 100 €	58 900 €	53 000 €	70 600 €	88 300 €
90 kW	21 200 €	28 300 €	35 300 €	42 400 €	56 500 €	70 600 €	63 600 €	84 800 €	105 900 €
110 kW	25 900 €	34 600 €	43 200 €	51 800 €	69 100 €	86 300 €	77 700 €	103 600 €	129 500 €
132 kW	31 100 €	41 500 €	51 800 €	62 200 €	82 900 €	103 600 €	93 200 €	124 300 €	155 300 €
160 kW	37 700 €	50 200 €	62 800 €	75 300 €	100 400 €	125 500 €	113 000 €	150 600 €	188 300 €
200 kW	47 100 €	62 800 €	78 500 €	94 200 €	125 500 €	156 900 €	141 200 €	188 300 €	235 300 €
250 kW	58 900 €	78 500 €	98 100 €	117 700 €	156 900 €	196 100 €	176 500 €	235 300 €	294 200 €
315 kW	74 200 €	98 900 €	123 600 €	148 300 €	197 700 €	247 100 €	222 400 €	296 500 €	370 600 €

Energy first!

It always pays to think about the future, and this is doubly true if you're thinking of buying a new screw compressor. With a compressor that you will run for 10 to 20 years, you will have a number of costs associated with it, such as the purchase of the machine, its installation, regular maintenance or dealing with breakdowns. However, the main cost is the electricity needed for machine run.

Based on our experience, electricity costs account for more than 80% of all costs over a 10-year time horizon. This is roughly 14 times more than the purchase price of a compressor. It is therefore definitely worth finding out about how economical the machine you are considering is before you buy it.

Especially at a time of extreme growth in electricity bills...



SCR compressors saving solutions

All SCR compressor series have been designed with the highest possible energy efficiency in mind and feature many innovative and advanced features to help reduce the cost of electricity and compressed air production in the industrial and energy sectors. Solutions that help reduce the cost of compressor operation include:

- **variable speed control**
- **two-stage compression**
- **lossless direct drive**
- **permanent magnet motor IE4**
- **output pressure setting**
- **economical weekly plan**
- **fan with speed control**
- **low pressure designs**
- **oil-free compressors**

In the following text of our overview of possible savings, we will present these individual solutions so that you can better understand the differences between the different types of compressors on the market and choose the most optimal solution for you.

Variable speed control

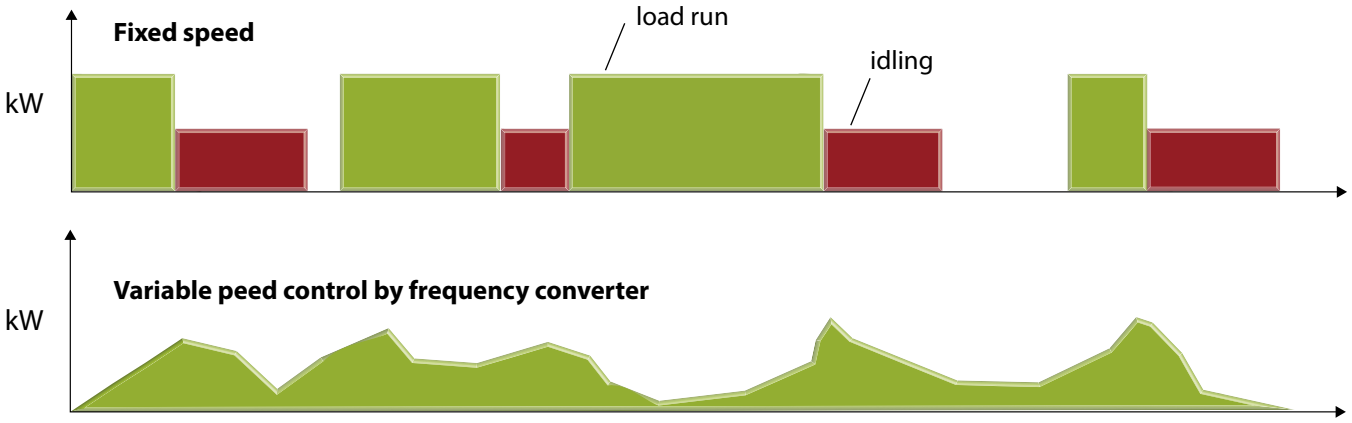
savings up to 35%

There are two basic ways of controlling compressor operation on the market:

- fixed speed (FS) compressors
- compressors with continuous speed control by means of a frequency converter (variable speed drive - VSD).

Fixed speed compressors have two pressure settings - switching on and off. If the pressure drops below the cut-off value, the compressor switches on the main motor and starts producing compressed air. As soon as it reaches the cut-off pressure, the compressor switches off in such a way that it first goes into **idling** (also relief), when the motor and the airend rotate, but the suction valve is switched off and the compressor does not produce air. Only after a certain time, in the order of a few tens of seconds to a few minutes, the machine is completely switched off.

Modern compressors with variable speed control work differently. They have an output pressure setpoint around which they try to maintain compressor output. If the production of air consumption increases, the pressure starts to drop and the frequency converter responds to the drop by increasing the speed of the electric motor and the compressor starts to produce more air. If the air consumption falls down, the frequency converter reduces the speed and the machine produces less air. Idling is also present in continuously variable compressors, but only to a very limited extent and only when the speed drops below the minimum level of the speed range.



How much idle time do I have?

Look in the compressor unit, where you will often find both the total number of operating hours and the number of hours running under load or idle.

The amount of energy used for idling can then be found by multiplying the observed hours by the power input of the motor in idling mode (either refer to the technical data sheets or use an approximate coefficient of 0.2 - 0.3 × the rated power input of the machine).

From an energy point of view, the main problem with fixed-speed compressors is the presence of idling, where the compressor only consumes electricity but does not produce air. These losses are practically absent in compressors with frequency converters. The amount of idling and therefore potential energy savings depends on how air consumption is varied. The smaller the amount of air required compared to the maximum output of the compressor, the shorter the duty cycles and the more idling.

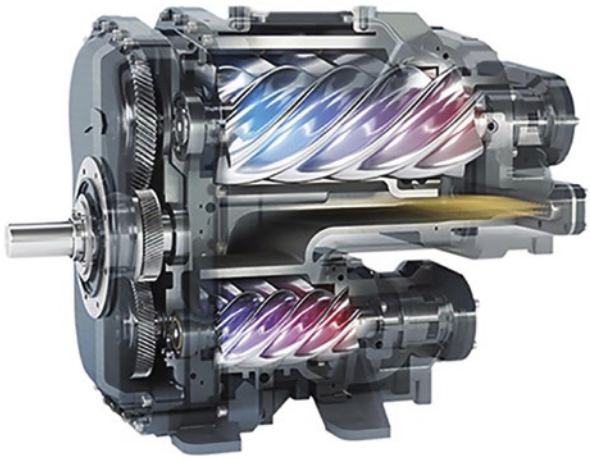
Typically, a compressor with variable speed control can save around 35% energy.

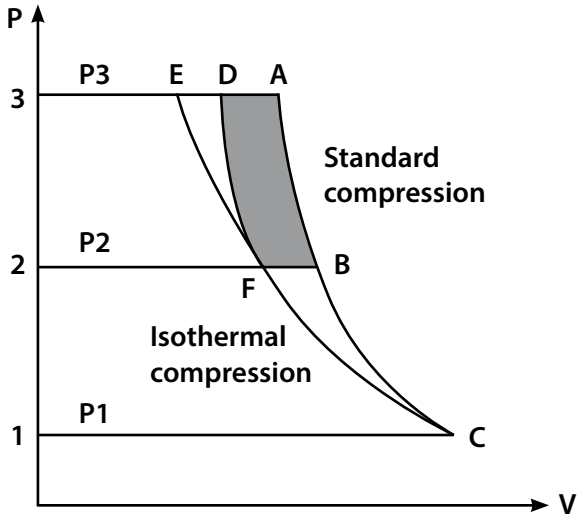
Two-stage compressors

savings up to 15%

Standard screw compressors use only one airend for air compression. Compression to the desired pressure thus occurs in only one step, the so-called stage. The advantage of single-stage compression is low cost, but from an energy point of view this method is not economical.

During air compression, a significant part of the supplied energy is converted into heat and the consequence of this phenomenon is a reduction in efficiency and the production of significantly less air compared to the ideal physical process in the so-called isothermal state, when all the supplied energy is used exclusively for gas compression and no heat is generated. For higher compression efficiency, two-stage compressors have been developed that use 2 airends connected to each other by a gear train.





The compression occurs in such a way that the air is first compressed by the larger airend to pressure P2 (point B). It is subsequently cooled in an intercooler, thus approaching the ideal isothermal compression state (point F). In the last step, it is compressed in the second stage by a second, smaller airend to the resulting pressure P3 (point D).

The differences in energy savings are evident in the area bounded by the ABFD points and can reach up to 15% compared to single stage compression.

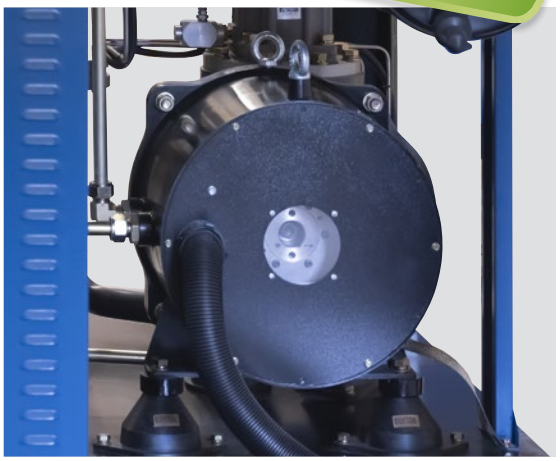
In addition to the increase in compression efficiency, another undeniable advantage of two-stage screw compressors is the lower outlet air temperature, which results in less condensate and thus increases the quality of the supplied compressed air.

SCR offers a two-stage compression solution on several product lines, starting at 90 kW. The disadvantage of machines with two-stage compression is the higher purchase price due to the two airends and gearbox, but the energy savings are well worth the investment costs.

Reference sample:
installation of 2 SCR-HV two-stage compressors with an input power of 250 kW and a supply voltage of 10 kV
application: *cement production*

Electric motor IE4 with permanent magnets

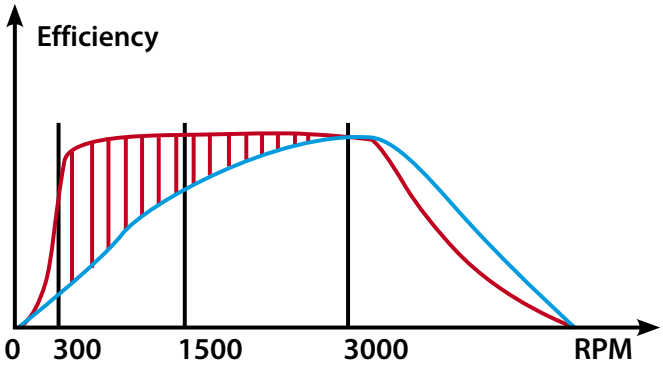
savings up to 5%



Electric motors used on compressors must, according to IEC EN 60034 from January 1, 2017 have an efficiency of at least IE3 for power inputs from 0.75 kW, and IE2 is sufficient for speed control.

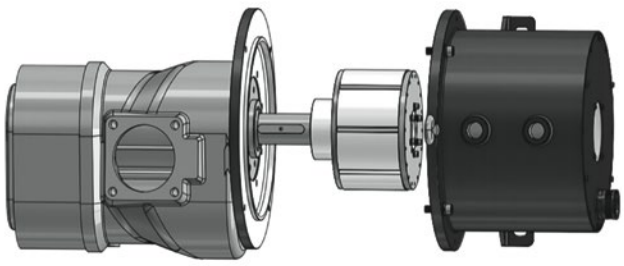
However, modern compressors use higher efficiency electric motors and the most well-known solution is permanent magnet (PM) motors, whose efficiency exceeds IE4 efficiency requirements. The differences in efficiency and energy savings achieved between IE3 and IE2 standards and PM motors on SCR machines can be found in the table below and typically 2 - 5% energy savings can be achieved compared to IE2 versions.

SCR series	Power input kW	Engine SCR	Efficiency according to IEC EN 60034		
			IE4	IE3	IE2
SCR-PM2	7.5	93.0%	91.7%	90.1%	88.1%
	11	93.5%	92.6%	91.2%	89.4%
	15	93.5%	93.3%	91.9%	90.3%
SCR-PM	22	96.0%	94.5%	93.0%	91.6%
	30	95.8%	94.9%	93.6%	92.3%
	37	95.6%	95.2%	93.9%	92.7%
	45	95.8%	95.4%	94.2%	93.1%
	55	96.0%	95.7%	94.6%	93.5%
	75	96.1%	96.0%	95.0%	94.0%



- **maintenance-free** - PM motors have no bearings and there is no need to lubricate and replace them
- **service life** - thanks to the absence of bearings, the motor life exceeds 100,000 operating hours
- **low noise** - SCR uses oil or liquid cooled motors without a fan
- **better cooling** - oil and liquid cooling provides more efficient cooling at low speeds
- **endurance** - PM motors are IP65 electrically rated and provide perfect protection against dust and water
- **protection** - motors are equipped with thermistor protection placed directly in the winding as standard

However, permanent magnet motors achieve even greater savings when used on machines with variable speed control by frequency converters. The efficiency of PM motors compared to conventional asynchronous motors is even higher in the low speed range, which can be seen in the graph above, where asynchronous motors are represented by the blue curve and PM motors by the red curve. PM motors used on SCR compressors have many other advantages that every user will appreciate during the long-term operation of the purchased screw compressor.



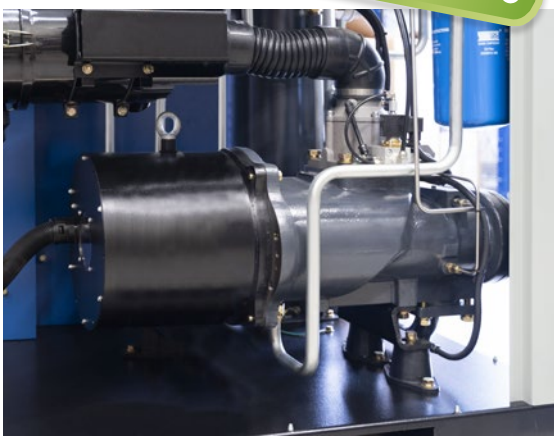
No loss direct drive 1 : 1

savings up to 10%

The transmission between the airend and the electric motor is realized in four ways in screw compressors:

- using V-belts
- elastic coupling
- gearbox
- direct coupling, the characteristics of which depend greatly on whether it is used in conjunction with a conventional electric motor or in conjunction with a permanent magnet bearingless motor.

A comparison between the different types of transfers is given in the following table:



Type of transfer	V-belts	Elastic coupling	Gearbox	Direct drive	
				connection with the normal engine	connection with PM engine
losses in the system	2 - 3% new belts up to 10% during operation	< 0.5%	< 0.5%	none	none
maintenance	belt tensioning replacements of belts and pulleys	clutch element replacements	replacement of gearbox wheels and seals	none	none
risks	belt breakage bearings damage due to poor tensioning	bearing stress in the axis direction	none	in case of bearing damage, transfer of damage from the block to the motor	none
price	low	medium	high	very low	very low

The traditional **V-belt** transmission is nowadays considered obsolete for screw compressors and is practically only used in very small machines, backup compressors and can be found on the market on very cheap machines. If we are talking about efficiency, this is the worst possible option. Even with new, high-end belts tensioned to the correct frequency, losses are in the range of 2-3%. However, due to wear and insufficient belt tension, losses are usually much higher and often approach 10%. In addition, there are costs associated with V-belts in tensioning and replacing belts and pulleys, as well as a relatively high risk of accidents due to belt breakage.

Modern screw compressors use a **coupling direct drive** or **gearbox transmission**. These connections between the airend and the electric motor provide long-term, stable high efficiency energy transfer from the motor to the airend and are reported to have losses of up to 0.5%. However, the disadvantage of these gearboxes is their maintenance. Coupling direct drive and gearbox costs are associated with replacing the elastic coupling element, gears or seals, which are both time-consuming and expensive.

If the screw compressors are equipped with a bearingless motor with permanent magnets, its design allows the use of a **direct connection 1 : 1**, which is completely lossless and does not require any maintenance. For this reason, SCR uses a combination of PM motors with a direct screw block connection in modern series.

Flexible pressure adjustment

savings up to 15%

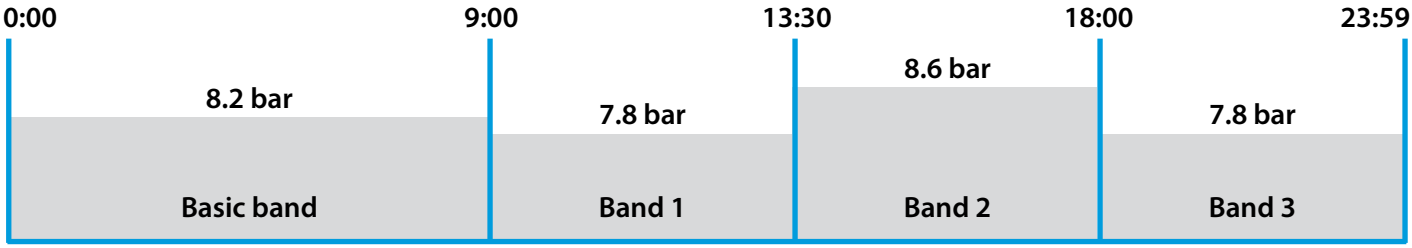
Compressing the air consumes energy. The higher the pressure, the more energy the compressor needs to achieve it. Always keep in mind that:

An extra 1 bar of air compression means approximately 7% of the energy expended!

A well-chosen compressor should therefore have an output pressure slightly above the required level, so that it does not consume unnecessary energy for excessive compression, which will then be released. Unfortunately, we often witness situations where the user operates a compressor with a supplied pressure of, for example, 10 bar and then the pressure is reduced to, for example, 6 bar on all input regulators to the machines. Judge the economics of such a solution for yourself...

A modern compressor should therefore allow comfortable and simple adjustment of the output pressure, which is realised by functions on the controller that can significantly influence the resulting energy efficiency of the machine. All SCR compressors are equipped with control units that allow pressure changes.

Another cost-saving feature in SCR controllers related to achieving savings on unnecessarily high outlet pressure is the possibility of setting so-called **pressure bands**. If different pressures are needed during the day, you can set up several time zones and assign the required output pressure to each zone. This optimizes the losses due to unnecessary pressure for periods of time when it is not needed.



Smart compressor shutdown

savings up to 10%

A major problem in manufacturing plants is the presence of compressed air leaks, which are usually around 20%, but significantly higher values can be encountered. Leaks in the piping system are always present, even when production is not taking place, e.g. at the weekend, at night or during breaks between shifts. It is therefore extremely convenient to turn off the compressors temporarily during this time so that they do not produce air only to cover leaks in the air pipe network.

On modern controllers used on SCR compressors, it is possible to set a weekly schedule for compressor operation and set several periods of time each day from Monday to Sunday when the compressor is on and when it is off.

Day	Time from	Time to	Status
Mon - Fri	0:00	5:59	off
	6:00	21:59	on
	22:00	23:59	off
Sat - Sun	0:00	23:59	off

Model example:

- *manufacturing plant with air leakage of 20% of air consumption and 2-shift operation with free weekend*
- *free time is 8 h × 5 working days + 48 h at the weekend = 88 hours, which is 52% of the time*
- *by switching off the compressor during off-shift hours, you save 0.52 × 0.2 = 10.4%*

Low pressure applications 1,5-5 bar

savings up to 20%

In industry there are many applications that need lower pressure than the common 7 - 10 bar supplied by screw compressors. Such applications are most often found in the glass, plastics, textile or cement industries and require compressed air pressures **of typically 1.5 to 5 bar.**

Glassworks shaping, sorting, transporting and cooling of glass
required pressure 3 - 4 bar

Building materials transport of cement
required pressure 4 bar

Textile industry
required pressure 1.5 - 5 bar

Plastic industry, cup making machine, pressure 5 bar needed

In these so-called **low pressure applications**, it is not sufficient to produce air using blowers, whose upper limit of pressure performance ends at an overpressure of about 1.5 bar, and therefore conventional screw compressors are used, which have an output pressure of about 7-10 bar. Although speed controlled compressors allow reducing the delivered pressure to a level of 4 - 5 bar, they face 2 major problems:

- **pressure range 4 - 5 bar** - conventional compressors are not optimised for 4 - 5 bar and energy efficiency is very poor in this range

- **pressure range 1.5 - 4 bar** - compressors must produce a pressure of at least 4 bar anyway, which is then reduced to the required pressure in the range of 1.5 - 4 bar

SCR has the optimum solution for low pressure applications - the **SCR-L low pressure compressors**, whose airends and other components are fully optimized for the supplied pressure range of 1.5 to 4 bar and whose **efficiency is** on **average 15-20% higher** than traditional compressor solutions. Our SCR-L series are available from 37 kW.

Oil-free compressors

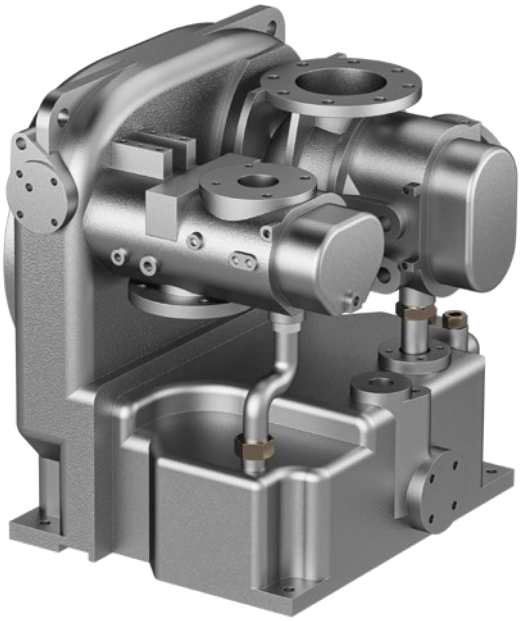
savings on maintenance

Some critical industrial applications require the supply of oil-free compressed air. These are mainly in the beverage industry, the food industry, the hospital and pharmaceutical sectors, and the supply of industrial breathable air for blasting or paint shops. Oil-free compressed air is defined by ISO 8573-1 as Class 0 and can be produced either by a conventional compressor with an appropriate air treatment system or directly by an oil-free compressor.

The use of oil-free compressors is becoming more and more suitable even outside these critical applications, mainly because of the zero risk of air quality reduction due to oil leakage, but also because of the **significantly lower investment and maintenance costs of** the technology.

The main savings of oil-free compressors:

- **no need to install filters and activated carbon columns**
- **no need to install water oil separator**
- **no oil changes**
- **no oil and separation filter changes in the compressor**
- **no need to clean the oil cooler**
- **no maintenance of thermostatic valve and check valve**
- **solid particle filter elements have longer maintenance**
- **no need to replace separator cartridges**
- **no need for condensate quality tests**
- **no waste water legislation**
- **eliminates oil receiver pressure inspections of the oil reservoir in the compressor**



In the field of oil-free compressors, the SCR brand portfolio offers both SCR-XA scroll compressors providing oil-free air delivery solutions with power range from 2,2 to 45 kW and SCR-G oil-free screw compressors with power range from 37 to 280 kW.

Speed controlled fan

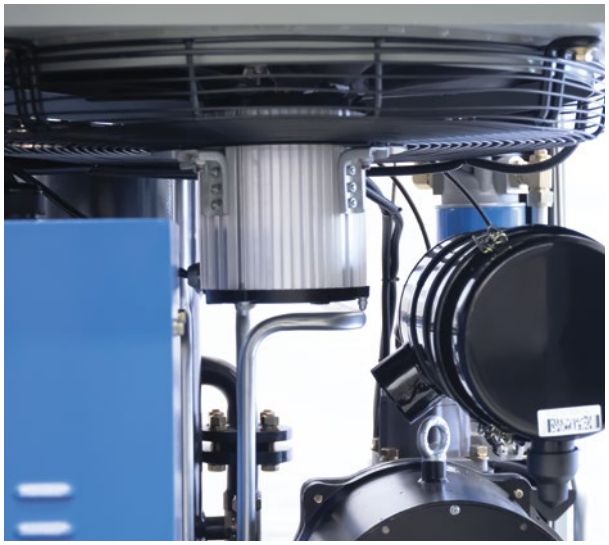
savings up to 2%

Each compressor is equipped with a fan that provides exhaust for the hot air present inside the compressor and provides cooling for the oil and air cooler.

The energy consumption of the fan is typically 2 to 5% of the total power input of the compressor.

Modern screw compressors use both efficient fans in terms of blade geometry and design, as well as continuous speed control via a frequency converter. The temperature in the compressor is controlled by sensor and when the limit temperature is reached, the fan is switched on and its rotation speed is gradually adapted to the cooling requirements.

Thanks to the regulation, the fan motor only draws the actual amount of electricity needed and, compared to the traditional solution where the fan runs completely unregulated, the electricity consumption is extremely reduced by tens of percent, which means a few percent of the total energy consumption of the compressor.



SCR-PM2 (7.5-15 kW)

Variable speed compressors with direct drive and PM-motor IE4

Pressure versions: 7 / 8 / 10 bar
FAD performance: 57 - 144 Nm³/h

SCR-PM (22-75 kW)

Variable speed compressors with direct drive and PM-motor IE4

Pressure versions: 7 / 8 / 10 bar
FAD performance: 48 - 798 Nm³/h

SCR-EPM2 (55-160 kW)

Variable speed compressors with direct drive and PM-motor IE4

Pressure versions: 7 / 8 / 10 bar
FAD performance: 600 - 1 980 Nm³/h

SCR-D (7.5-75 kW)

Fixed speed compressors, direct drive with coupling

Pressure versions: 7 / 8 / 10 bar
FAD performance: 60 - 798 Nm³/h

SCR-II (90-400 kW)

Fixed speed compressors, direct drive with coupling

Pressure versions: 7 / 8 / 10 / 12,5 bar
FAD performance: 750 - 4 146 Nm³/h

SCR-DV (22-200 kW)

Variable speed compressors, direct drive with coupling

Pressure versions: 7 / 8 / 10 / 12,5 bar
FAD performance: 210 - 2 106 Nm³/h

SCR-H (90-315 kW)

2-stage screw compressors with fixed speed (H) or variable speed (HV)

Pressure versions: 7 / 8 / 10 / 12,5 bar
FAD performance: 840 - 4 080 Nm³/h

SCR-LB (37-200 kW)

Low-pressure screw compressors with fixed speed (LB) or speed control and PM motor (LBPM)

Pressure versions: 1,5 / 3 / 4 / 5 bar
FAD performance: 720 - 3 000 Nm³/h

SCR-M (5.5-75 kW)

Fixed speed compressors with V-belt transmission

Pressure versions: 7 / 8 / 10 / 12,5 bar
FAD performance: 36 - 798 Nm³/h

SCR-XA (2.2-45 kW)

Oil-free
scroll compressors

Pressure versions: 8 / 10 bar
FAD performance: 18 - 300 Nm³/h

SCR-G (55-250 kW)

Oil-free screw compressors, two-stage with fixed speed

Pressure versions: 7 / 8 / 10 bar
FAD performance: 462 - 2 700 Nm³/h

SCR-GV (37-280 kW)

Oil-free screw compressors, two-stage with variable speed

Pressure versions: 7 / 8 / 10 bar
FAD performance: 276 - 2 910 Nm³/h

SCR compressors saving solutions

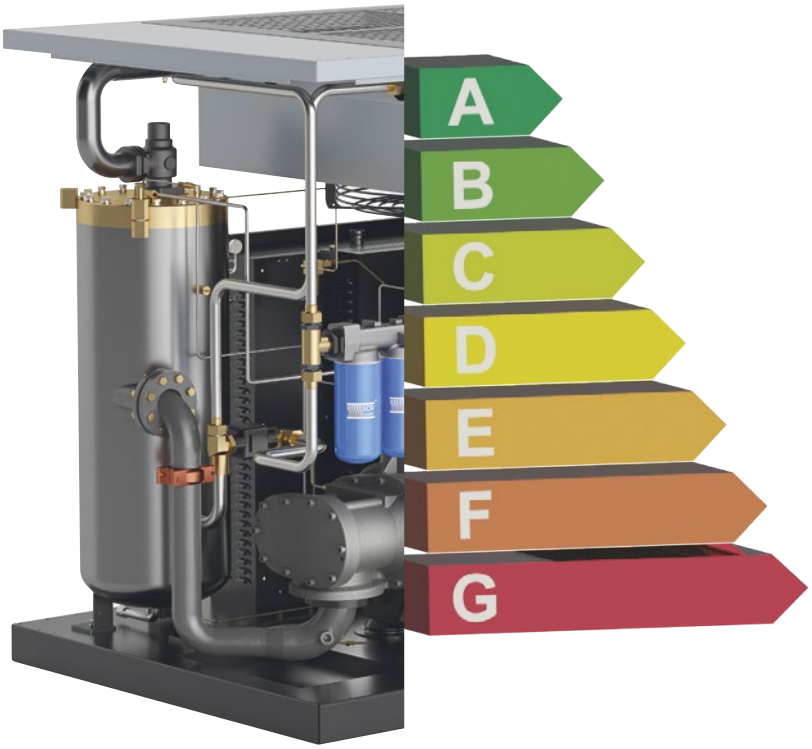
One of SCR's main goals is to bring very modern and energy-efficient machines to the market. Each of the SCR compressors has some energy saving features, which are described in our information brochure.

The individual energy saving solutions for each SCR compressor series are listed in the table below:

Overview of energy-saving solutions

SCR series	transmission	run mode	power (kW)	speed control	2-stage	direct drive	PM-motor IE4	pressure zones	weekly schedule	VSD fan	oil-free
SCR-PM2	direct	VSD	7.5 - 15	✓		✓	✓		✓		
SCR-PM	direct	VSD	22 - 75	✓		✓	✓	✓	✓	✓	
SCR-EPM2	direct	VSD	55 - 160	✓		✓	✓	✓	✓	✓	
SCR-M	V-belts	FS	5.5 - 75								
SCR-D	coupling	FS	22 - 75						✓		
SCR-II	coupling	FS	90 - 400						✓		
SCR-DV	coupling	VSD	22 - 200	✓					✓		
SCR-H	gearbox	FS	90 - 315		✓				✓		
SCR-HV	gearbox	VSD	90 - 315	✓	✓				✓	✓	
SCR-LB	coupling	FS	37 - 250						✓		
SCR-LBPM	coupling	VSD	37 - 250	✓			✓		✓	✓	
SCR-LH	coupling	FS	55 - 250		✓				✓		
SCR-LHPM	coupling	VSD	55 - 250	✓	✓		✓		✓	✓	
SCR-XA	V-belts	FS	2.2 - 45						✓		✓
SCR-G	gearbox	FS	55 - 250		✓				✓		✓
SCR-GV	gearbox	VSD	37 - 280	✓	✓				✓		✓

SCR AUDIT - find out how much you can save!



If you need help to achieve energy savings and are not sure what the optimal solution is, contact our company.

We have a lot of experiences with compressor room design and energy cost optimization in existing compressor rooms, based on which we have prepared a concept for the assessment of the current situation in the form of an SCR AUDIT.

If you decide to use SCR AUDIT, we will visit your facility and conduct an audit as part of the process:

- comprehensive assessment of the current state of compressors
- assessment of the air treatment system
- measurement of compressed air consumption
- detection and quantification of air leaks

Based on the data and measurement results, we will prepare a final report that will include a description of the existing solution, a balance of the data, an evaluation of the savings potential and suggestions for individual solutions for your compressed air production, treatment and distribution system. Based on the results of the SCR AUDIT, you can then implement effective steps and measures to achieve the necessary savings.

SCR - more than 140 000 installations already

Over the past 20 years, more than 140 000 pieces of SCR compressors have been installed worldwide, often subjected to the harshest operating conditions, from Scandinavian freezing temperatures and desert dust to the high temperatures and extreme humidity of Latin America and Indochina. Thanks to their state-of-the-art components and precise production control system, SCR compressors have stood up to the toughest tests in industry, energy and other areas with a need for highly efficient compressed air production. Since 2020, the SCR brand is newly represented in the Czech Republic and we believe that it will gain a large number of satisfied users in our country as well.

Distributor of SCR compressors
for the Czech and Slovak Republics:

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Hřbitovní 1324/27a
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Website	www.scr-kompresory.cz

Your expert dealer: