Pindari destratification trial – conceptual pneumatics design

WRL TR 2023/05, March 2024

By F C Chaaya and B M Miller

UNSW Water Research Laboratory

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1 Overview

Cold water pollution in reservoirs is a complex issue caused by stratification, with a range of ecological, environmental and social impacts. Despite a recognition of cold water pollution in NSW for almost two decades, it remains an issue downstream of many large storage dams. An international literature review undertaken by the UNSW Sydney Water Research Laboratory (WRL) investigated causes and impacts of, and options for mitigating cold water pollution (Chaaya and Miller, 2022). This review highlighted artificial destratification via bubble plumes as the only mitigation option capable of addressing both cold water pollution and other water quality impacts caused by reservoir stratification. The successful application of bubble plume destratification in large storage reservoirs was found to be limited, primarily due to the significant operational costs at larger scales. As such, renewable energy and optimised operational procedures are considered a necessity for feasible artificial destratification via bubble plumes in large reservoirs.

Given the limited successful application of bubble plume destratification in large reservoirs, especially in NSW, a pilot trial destratification system is recommended to demonstrate feasibility. WRL was previously engaged by the NSW Department of Primary Industry – Fisheries (DPI Fisheries) to investigate and recommend a NSW dam at which to undertake these destratification trials. Pindari Dam located on the Severn River (Figure 1-1), one of eight high-priority dams outlined as part of the previous cold water pollution mitigating works in NSW (NSW Cold Water Pollution Interagency Group, 2012), was deemed the most appropriate.

An additional report has reviewed the data and literature pertaining to cold water pollution at Pindari Dam for DPI Fisheries (Chaaya and Miller, 2023a). This provides a preliminary system design that is based on limited available data and identifies gaps in current monitoring. These gaps should be addressed prior to the commissioning of a fully operational destratification system at Pindari Dam. Specific monitoring will be required to assess key short-term (hours to days) and long-term (weeks to months) effects of artificial destratification on cold water pollution and other water quality parameters, as well as facilitate the ongoing refinement of operational procedures.

WRL was engaged by DPI Fisheries to provide options and recommendations for the design of key components for the Pindari Dam bubble plume artificial destratification trials, including:

- Monitoring – to fill the previously identified gaps in monitoring
- Operational procedures and power refinement – working collaboratively with external consultants to refine operational procedures to make effective use of renewables
- Pneumatics – investigating pipeline and diffuser design to maximise system efficiency
- Compressor design – recommendations on specific compressors based on airflow rate requirements

A previous report provided to DPI Fisheries (Chaaya and Miller, 2023b) made recommendations for the monitoring component of the artificial destratification trials. This report provides conceptual design details for the remaining three components in the following sections:

- Section 2 provides design air flow rates required to destratify Pindari based on numerical modelling (operational procedures, pneumatics and compressor design)
- Section 3 provides the total pressure requirements of a compressor system (pneumatics, compressor design)

- Section 4 provides information on suitable compressors from the two manufacturers engaged as part of this design
- Section 5 indicates the power requirements of a destratification system suitable for the trial
- Section 6 provides information regarding power currently available on site and potential installation locations based on an initial site visit conducted by WRL, DPI Fisheries and WaterNSW staff

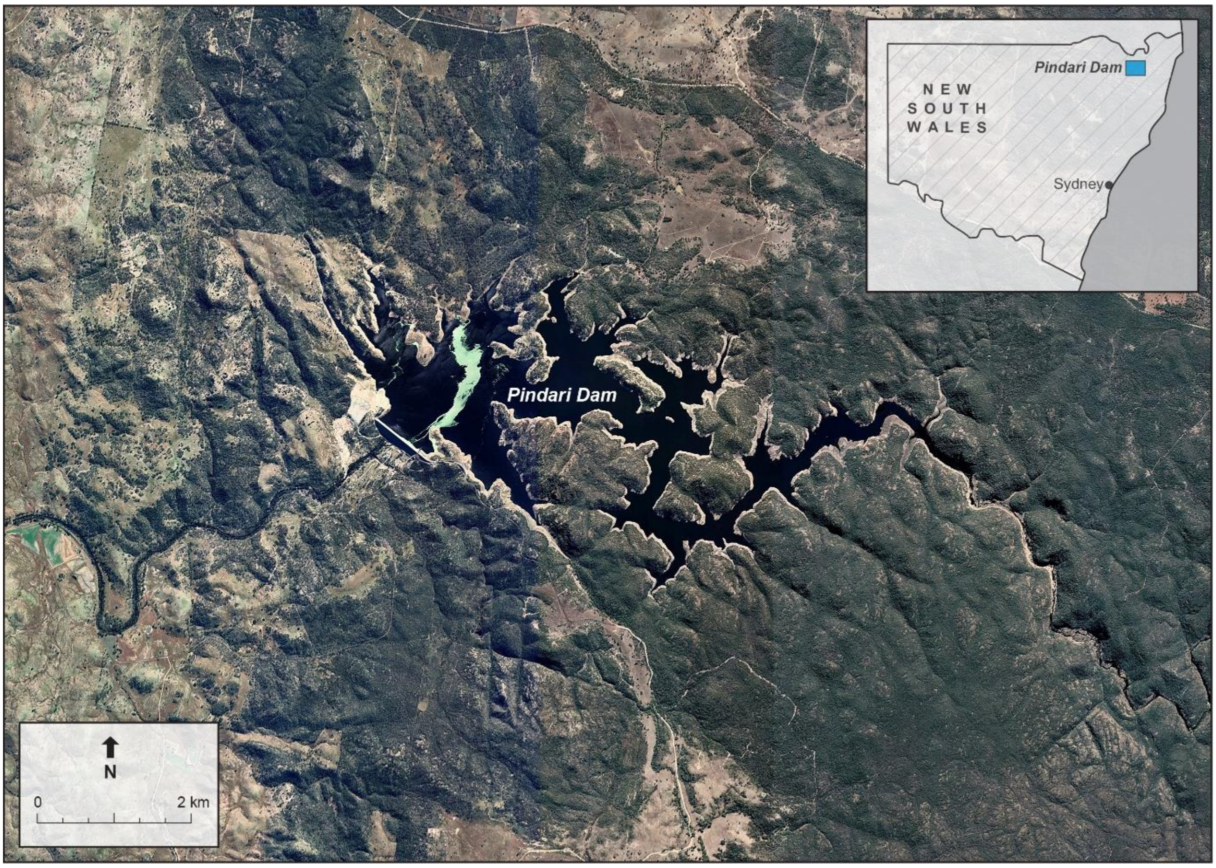

Figure 1-1 Pindari Dam location

2 Airflow requirements

WRL has previously investigated airflow requirements for a destratification system suitable for Pindari Dam. Initial airflow rates were determined using the methodology for bubble plume design outlined by Schladow (1992, 1993). This methodology defines the isothermal work of compression (W_{iso}) required to completely destratify a reservoir in a stratified state, based on the difference in the potential energy (PE) of the system in both states. This considers a mechanical efficiency (η_{mech}), which represents the capability of the destratification system to convert the work input by the compressor to work done to destratify the reservoir, such that:

$$\eta_{mech} = \frac{PE_f - PE_i}{W_{iso}}$$

This methodology is detailed in a report previously provided to DPI Fisheries (Chaaya and Miller, 2023a). The flow rates determined using this methodology were tested numerically using the AEM3D model (https://www.hydronumerics.com.au/software/aquatic-ecosystem-model-3d). Results of this investigation indicated:

- A minimum of 500 L/s continuous (i.e. 24 hours per day) airflow rate would be required to maintain destratification in Pindari reservoir
- Up to 2,500 L/s destratification might be required to ensure the reservoir doesn't stratify under continuous, extreme summer conditions

AEM3D modelling was used to further investigate power refinement operational procedures, including continuous operation (24 hours per day), intermittent operation during daylight hours (8 hours per day) and a demand management scheme with an hour of down time (23 hours per day). The results of this modelling are summarised in Miller and Chaaya (2024).

These investigations found that as airflow rates were increased up to 1,000 L/s, the effective destratification also increased over a 30, 60 and 90 day period. For flow rates above 1,000 L/s, the amount of additional destratification was minimal.

Intermittent operation for 8 hours per day was found to be less effective in destratifying the reservoir over a 90 day period than the linearly equivalent continuous operation (i.e. three times more airflow rate).

Ceasing operation for an hour each day was observed to have minimal effect on the overall effectiveness of a continuous operation scheme.

Based on these results, it is recommended that the compressor(s) selected for the Pindari artificial destratification trial be capable of producing 1,000 L/s airflow rate.

3 Total pressure requirements

The compressor specifications and pipeline design are, in part, governed by the pneumatics of the destratification system. In particular, the compressor working pressure is required to overcome:

- The static pressure head created by the water column above the diffuser
- The additional pressure required to purge the diffuser and distribution pipeline of water when operation commences
- Pressure losses along the distribution pipeline and diffuser due to friction and changes in direction (i.e. elbows)
- Headloss through the diffuser nozzles

In summary, the total pressure requirements at the compressor will be approximately 8 bar.

3.1 Water column and atmospheric pressure head

The static pressure created by the water column and atmospheric pressure above the diffuser is the primary contributor to the total working pressure required at the compressor. The diffuser will be positioned along the deepest section of the reservoir (the thalweg) offset from the bed. It is not feasible to have the diffuser at the maximum depth of the reservoir (73 m at approximately 443 mAHD), due to bed stirring of sediments. Further, the V-shaped bathymetry of the reservoir results in only a small percentage of the total volume being contained in the deepest sections, so having the diffuser above the bed has minimal impact on full mixing. WaterNSW stage-storage data (Figure 3-1) indicates that 95% of the total maximum operating capacity exists above 465 mAHD. It is therefore assumed that the diffuser would be installed at a maximum depth of 51 m below the surface (465 mAHD) at full capacity (516 mAHD).

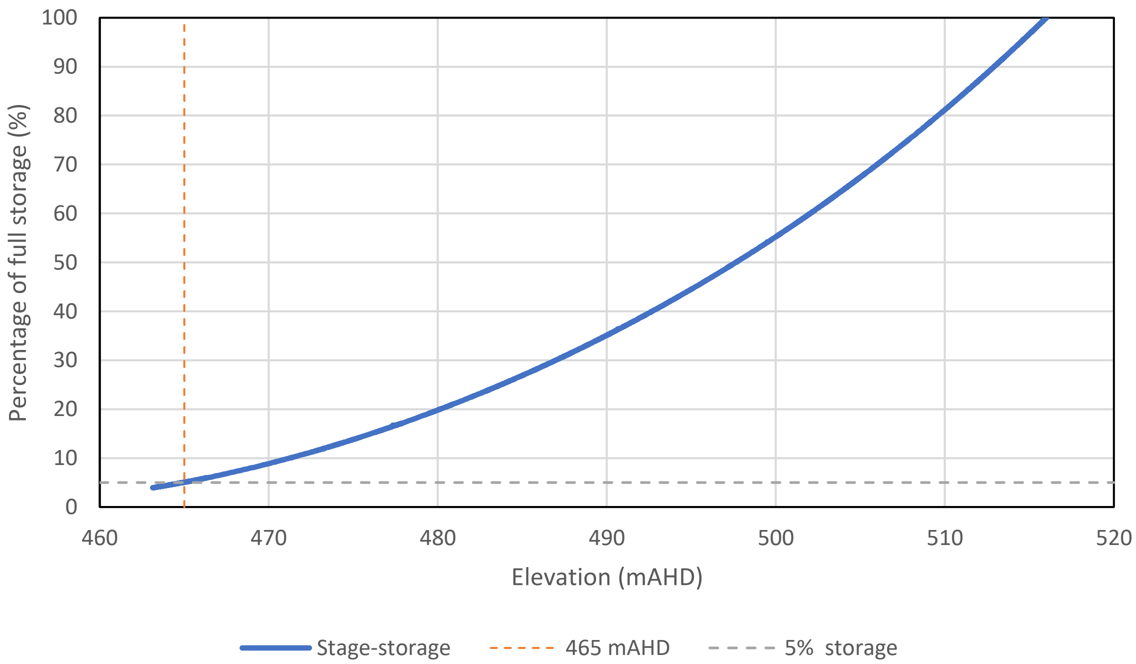

Figure 3-1 Pindari stage-storage curve

Compressor operating pressures are generally provided in units of bar. The static pressure head created by the 51 m of water can be calculated using the following conversion, and is approximately 5 bar.

$$1\ bar = 0.098\ mH_2 0$$

Atmospheric pressure is approximately 1 bar.

The operating pressure required to overcome the maximum water depth and atmospheric pressure above the diffuser is 6 bar.

3.2 Pressure required to purge the pipeline diffuser

This is a consideration for detailed design. In discussions with compressor manufacturers, it has been suggested that purging the pipeline and diffuser could require up to 0.5 bar additional work pressure.

3.3 Pressure losses through distribution pipeline

Pressure losses due to friction are overcome by correctly sizing the distribution and diffuser pipeline. A longer length of pipeline will result in increased pressure losses. The length of the distribution pipeline is determined by the installation location of the compressor system. Potential installation locations are discussed in Section 6.2. A maximum of approximately 1,000 m of distribution pipeline will be required if the compressor system is installed at the base of the dam (Figure 3-2).

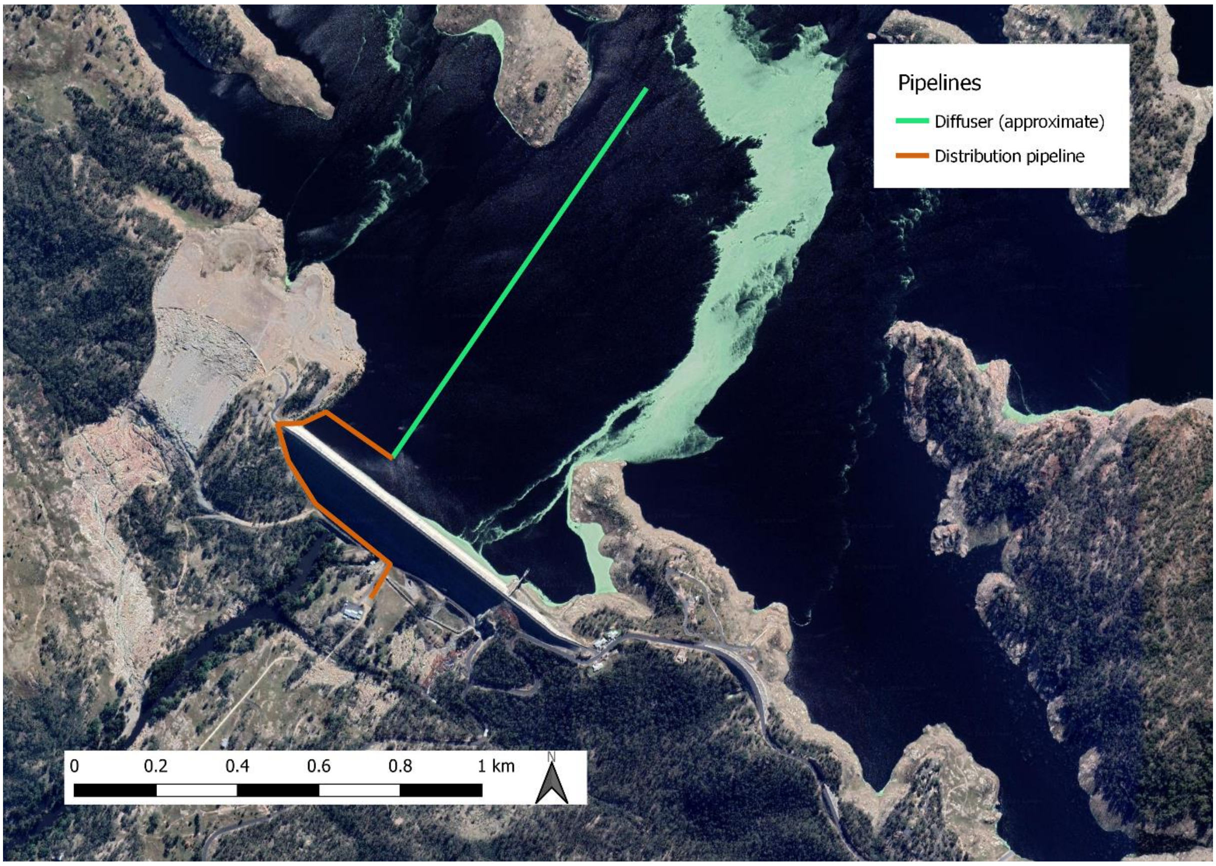

Figure 3-2 Pindari Dam with approximate maximum distribution pipeline length and diffuser (noting the length of the diffuser will be determined in detailed design)

The follow equation can be used to calculate pressure losses over the distribution pipe (Lewis et al., 1991):

$$P_L = \frac{K \times Q_T^{1.85} \times l}{d_p^5 \times P_I}$$

Where:

$$K = 1.6 \times 10^{12}$$
$$P_L = pressure\ loss\ (kPa)$$
$$Q_T = total\ free\ air\ flow\ rate\ \left(\frac{m^3}{s}\right)$$
$$l = total\ length\ of\ pipe\ (m)$$
$$d_p = inner\ diameter\ of\ pipe\ (mm)$$
$$P_I = absolute\ initial\ line\ pressure\ (kPa)$$

Table 3-1 demonstrates the effects of varied pipe diameters, assuming a distribution pipeline length of 1,000 m, total free air flow rate of 1 m^3/s (1,000 L/s) and an initial line pressure of 860 kPa (8.6 bar). Note that the 8.6 bar initial line pressure has been assumed from technical specifications provided by compressor manufacturers (see 4). This was chosen to overcome the pressure resulting from the static water column and atmospheric pressure (6 bar) and pressure require to purge the pipeline of water (approximately 0.5 bar).

Table 3-1 Pressure loss for varying pipe diameters

Diameter (mm)	Pressure loss (kPa)	Pressure loss (bar)
100	186	1.9
150	24	0.2
200	6	0.1
250	2	0.0
300	1	0.0

It is recommended that a 200 mm pipe diameter be adopted for the distribution pipeline and diffuser. Note that elbows along the distribution pipeline will result in additional pressure losses, however these are expected to be negligible with a 200 mm diameter pipe.

3.4 Pressure losses through the diffuser

The flowrates, port sizes and number of ports have been designed based upon previous WRL experience and the methods of Schladow (1992, 1993) and Lewis et al. (1991). Using a port diameter of 2 mm and 450 total ports, the headloss through the diffuser for 1000L/s total airflow would be 1.5 bar.

This has been determined based on the following equation of headloss through a port.

A3.3 Flow and Pressure Distribution in a Perforated Pipe

The pressure loss in a straight compressed air delivery pipeline is determined according to the following formula (Atlas Copco, 1976) :

$$P_L = K\, Q_T^{1.85}\, l/\left(d_p^{5}\, P_I\right) \qquad [kPa] \qquad \text{(A3.11)}$$

where K is a constant (1.6×10^{12}),

Q_T is the total free air flow rate ($m^3\ s^{-1}$),

d_p is the inner diameter of the pipe (mm),

l is the total length of the pipe, including fittings, etc (m),

P_I is the absolute initial line pressure (kPa).

Equation (A3.11) is applicable for most compressed air delivery systems, however, the constant (1.6×10^{12}) may vary somewhat depending on the internal pipe roughness. Pressure losses in polyethylene pipe systems [as calculated by (A3.11)] may be checked using supplier design charts. Given the delivery air flow rate (i.e. free air flow rate/compression ratio) and the pipeline inner diameter, the percent pressure drop per kilometre of pipe may be derived directly from these charts.

4 Compressor specifications

Compressor manufacturers CompAir (https://www.compair.com/en-au/) and Atlas Copco (https://www.atlascopco.com/en-au) were contacted for recommendations and quotations based on the design airflow rate (1,000 L/s) and working pressure (at least 8 bar) required for the Pindari destratification trial. Manufacturers provided a range of options to suit these parameters, including:

- Variable speed (VSD) oil-free compressors
- Fixed speed oil-free compressors
- Fixed speed oil-lubricated compressors

It is recommended that VSD compressor(s) are used for the Pindari destratification trial. One of the primary aims of the trial is to quantitatively understand the effects of varied airflow rates on effective destratification. A greater understanding of this will facilitate more cost effective operation of the destratification system and reduced power requirements. Additional, VSD compressors initiate with a lower power draw compared to the fixed speed alternatives.

It has been noted by manufacturers that operating a VSD compressor at maximum capacity long-term may negatively impact the longevity of compressor components. This should be considered in detailed design when choosing a compressor system capable of meeting the minimum 1,000 L/s requirement. Adopting a dual compressor system may overcome this issue.

Oil-lubricated compressors are a lower cost alternative to their oil-free equivalents. Oil-lubricated system should only be considered with the use of food-grade oil to avoid contamination of the reservoir water. Installation below the dam catchment (see discussion in Section 6.2) would mitigate the risk of contamination of the reservoir in a flood event, however risks to the downstream river should still be considered. Oil-lubricated systems are generally lower cost than their oil-free equivalents, and may be more suitable for trial purposes. Compressor manufacturers should be consulted to understand the expected risks of using an oil-lubricated system to supply air directly into the reservoir.

Quotes and technical specification sheets provided by manufacturers for each type of compressor are available in Appendix A and Appendix B . Note, the quotes provided are only preliminary estimates and should be revisited upon the completion of detailed design. Manufacturers indicated lead times may be anywhere up to 40 weeks from purchase to commissioning on site.

5 Power requirements

The total power requirements of the Pindari trial destratification system will depend on the chosen compressor type and manufacturer as part of detailed design. Estimates thus far have been provided to DPI Fisheries based on the Atlas Copco ZT250 VSD 8.6 Bar compressor system (with a 250 kW power rating). This system is capable of up to 645 L/s at maximum operating pressure. With two compressors, this results in a power requirement of approximately 400 kW to achieve 1,000 L/s airflow rate.

Long term modelling of environmental conditions to determine reduced power consumption (i.e. less stratification requiring less air delivery) has not yet been undertaken. However, it is unlikely that 400kW will be needed ongoing, and further the destratification system needs only to operate typically from September to April.

6 Site visit (21/03/2023)

The Pindari Dam site was visited by WRL, DPI Fisheries and WaterNSW staff on 21 March 2023 to undertake an initial investigation of the general site, investigate existing power infrastructure capabilities and determine potential installation locations for the compressor system based on available power infrastructure.

6.1 Existing power infrastructure and capabilities on site

Existing power infrastructure at Pindari Dam extended to the built area at the base of the dam wall. Two separate powerlines currently run to existing transformers capable of (TBC) 300 kVA and 200 kVA (Figure 6-1). Preliminary discussions suggest that the existing power infrastructure would be capable of supporting a 250 kW and 150 kW compressor, which satisfies the previously outlined power requirement of 400 kW.

Figure 6-1 Existing power infrastructure at base of Pindari Dam wall

Additional infrastructure (power lines) would be required to operate the compressors from a location other than at the base of the dam wall.

6.2 Potential compressor installation locations

Three locations were found suitable for compressor system installation:

- Location 1 – at the base of the dam wall, near existing power infrastructure
- Location 2 – on the road at the north-west end of the dam wall in the existing turning circle area
- Location 3 – on the bank between the dam wall and spillway

Figure 6-2 shows the locations and additional key locations on site (e.g. operator residence, for consideration of noise levels).

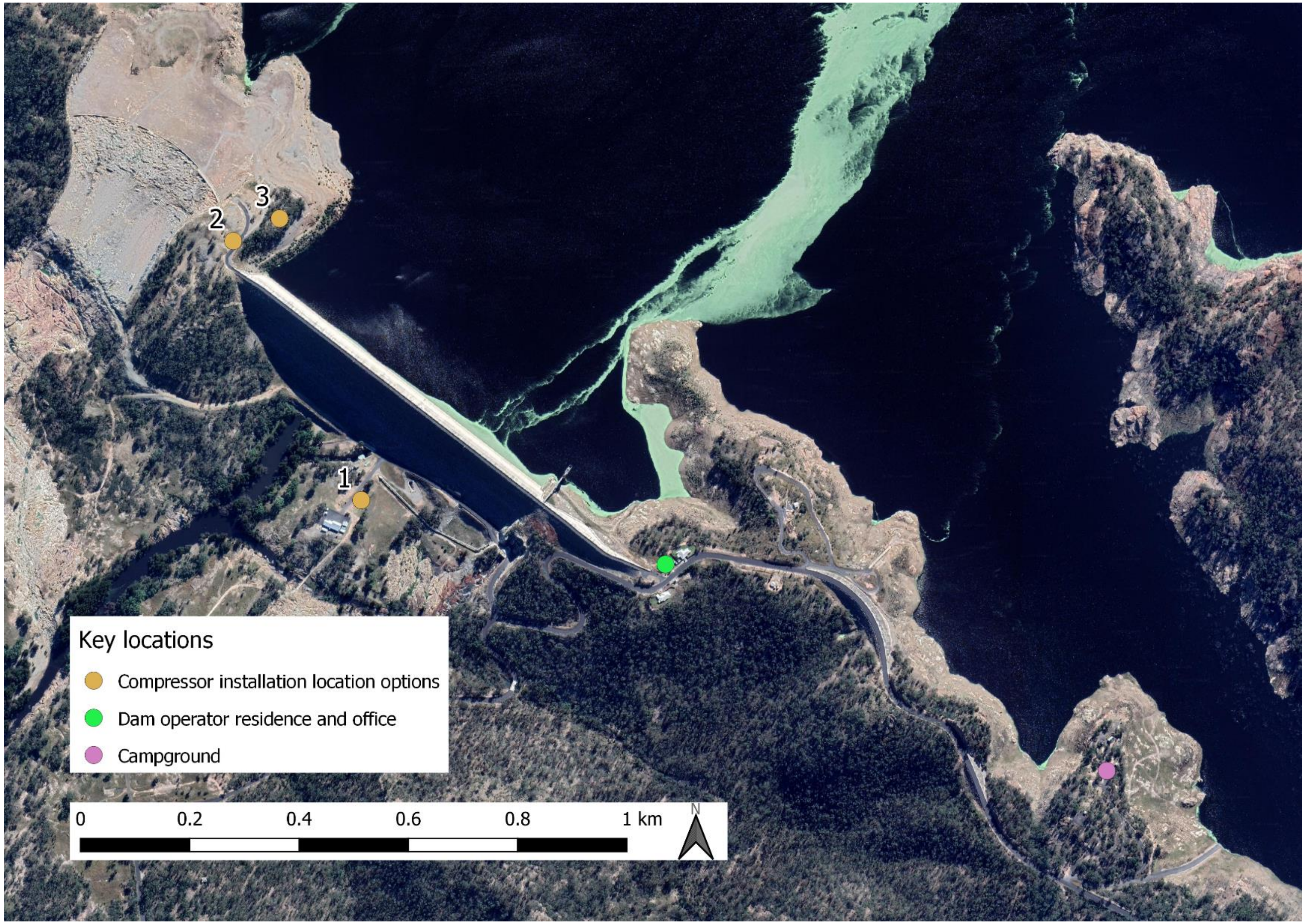

Figure 6-2 Key locations at Pindari Dam

Table 6-1 summarises the advantages and disadvantages of the three potential locations outlined.

Table 6-1 Advantages and disadvantages of potential compressor installation locations

Location	Advantages	Disadvantages
1	• Minimal additional power infrastructure required (powerlines and transformer) • No public access to the area • Existing road access • Below dam catchment area if fuel is stored on-site for generator power	• Closest location to the dam operator residence, office and campground (considering noise) • Requires the longest distribution pipeline to the diffuser in the reservoir • Compressors may require an additional slab • Requires additional civil works to run pipeline over the existing road
2	• Potential to install directly onto current road, eliminating the need for an additional slab • Existing road access • Limited public access to the area (no vehicles) • Furthest location from dam operator residence, office and campground (considering noise)	• Requires additional infrastructure (powerlines and transformer) to supply power from existing power infrastructure • Requires additional civil works to run pipeline over the existing road • Blocks existing turning circle • Within dam catchment area if fuel is stored on-site for generator power • Requires additional security measures (e.g. fencing) to limit public access to compressor units
3	• Shortest distribution pipeline required • Furthest location from dam operator residence, office and campground (considering noise) • No additional civil works required to run pipeline over the existing road	• Existing vehicle access is limited (unsealed road down irregular slope) • Within dam catchment area if fuel is stored on-site for generator power • Requires the construction of an additional slab to provide a stable surface for compressors and transformer • May affect site amenity

Considering these advantages and disadvantages, Location 1 is a preferred option. Installation at the base of the dam wall eliminates the need for significant additional, high-cost power infrastructure which may delay the project due to long lead times. This area is more secure, given the current public access limitations.

7 References

Chaaya, F. C. and Miller, B. M. (2022) A review of artificial destratification techniques for cold water pollution mitigation A review of artificial destratification techniques for cold water pollution mitigation. UNSW Water Research Laboratory Technical Report 2021/017

Chaaya, F. C. and Miller, B. M. (2023a) Pindari Dam – mitigating cold water pollution through artificial destratification. UNSW Water Research Laboratory Technical Report 2022/04

Chaaya, F. C. and Miller, B. M. (2023b) Pindari Dam cold water pollution mitigation through artificial destratification – monitoring network recommendations. UNSW Water Research Laboratory Technical Report 2022/19

Chaaya, F. C. and Miller, B. M. (2024) Pindari Destratification – numerical modelling of operational procedures to balance power requirements. UNSW Water Research Laboratory Technical Report 2024/05

NSW Cold Water Pollution Interagency Group. (2012) Cold Water Pollution Strategy in NSW – report on the implementation of stage one. NSW Department of Primary Industries, a division of NSW Department of Trade and Investment, Regional Infrastructure and Services. Available at: https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0009/456912/NSW-Cold-water-pollution-strategy-stage-one.pdf

Lewis, D. P., Patterson, J. C., Imberger, J., Wright, R. P. and Schladow, S. G. (1991) Modelling and Design of Bubble Plume Destratification Urban Water Research Association of Australia.

Schladow, S. G. (1992) 'Bubble plume dynamics in a stratified medium and the implications for water quality amelioration in lakes', Water Resources Research, 28(2), pp. 313–321. Doi: 10.1029/91WR02499.

Schladow, S. G. (1993) 'Lake Destratification by Bubble-Plume Systems: Design Methodology', Journal of Hydraulic Engineering, pp. 350–368. doi: 10.1061/(asce)0733-9429(1993)119:3(350).

Appendix A Atlas Copco – quotes and technical information

From: David Benbow
To: Fred Chaaya
Cc: Dennis Benson
Subject: RE: Compressors for Destratification in a Reservoir
Date: Friday, 16 September 2022 8:32:12 AM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png
Mapping ZT160 10 & ZT250VSD 8 6 bar UNSW.pdf
Microsoft Word - ZT_110_275_Product_Description_EN_Antwerp_ED_01.docx.pdf

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Hi Fred,

Thank you for requesting information around Destratification at Pindari dam.

From the Information provided we provide a Budget quotation based on the attached mapping.

This is based upon ZT250VSD 8.6 Bar Oil Free Air Compressor Plus ZT160 Fixed Speed 10 Bar Oil Free Air Compressor

- ZT250 VSD 8.6 Bar Budget quotation $460,474.84
- ZT160 Fixed Speed 10 Bar Budget Quotation $431,242.52
- Delivery to site excluding unloading $4,000.00
- Equipment Commissioning $5,000.00

ZT250VSD 8.6 Bar Flow is 808.44 Litre's / Second
ZT160 Fixed Speed Flow is 395.81 Litre's / Second

Delivery is currently approximately 40 Weeks

I have sent you drawing & Installation Drawings using Atlas Copco links

Best regards,

David Benbow
Sales Engineer
Oil Free/ Oil Injected
Compressed Air

Atlas Copco
Compressors
ABN 85 620 125 153

Address: Stenhouse Drive
Cameron Park
NSW
Phone: 96219634
Mobile: 0417 262 119

E-mail: david.benbow@atlascopco.com
Visit us at: http://www.atlascopco.com
Follow us at: *Facebook* / *Twitter* / *LinkedIn* / *YouTube*

From: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Sent: Thursday, 8 September 2022 10:20 AM
To: David Benbow <david.benbow@atlascopco.com>
Cc: Dennis Benson <dennis.benson@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hi David,

Thank you (and Dennis) for all the help you've provided so far!

A quotation tomorrow would be perfect. I may be out-of-office tomorrow, however if I can take your call I will. Otherwise I'll endeavour to contact you early Monday.

If you and/or Dennis feel like this opportunity is worth discussing in greater detail I am happy to set up a meeting so we can discuss as a collective. Otherwise, for now the client is most concerned about getting an idea of costs.

I appreciate you looking into this for me, and I hope you're enjoying Queensland! Perhaps there's a little more sunshine than what we're getting in Sydney currently.

Thanks,
Fred

From: David Benbow <david.benbow@atlascopco.com>
Sent: Thursday, 8 September 2022 10:11 AM
To: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Cc: Dennis Benson <dennis.benson@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hi Fred,

Thank you for talking with Atlas Copco regarding the Destratification in a Reservoir.

As we are in Qld until tomorrow a can provided your quotation latter tomorrow.

Do hope this meets with your approval.

Our engineering team can also provide support during installation and commissioning.

I will call you around 11.30 tomorrow

Best regards,

David Benbow
Sales Engineer
Oil Free/ Oil Injected
Compressed Air

Atlas Copco
Compressors
ABN 85 620 125 153

Address: Stenhouse Drive
Cameron Park
NSW
Phone: 96219634
Mobile: 0417 262 119

E-mail: david.benbow@atlascopco.com
Visit us at: http://www.atlascopco.com
Follow us at: *Facebook* / *Twitter* / *LinkedIn* / *YouTube*

From: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Sent: Wednesday, 7 September 2022 5:55 PM
To: Dennis Benson <dennis.benson@atlascopco.com>
Cc: David Benbow <david.benbow@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hey Dennis,

Our biggest concern is the airflow rate achievable. I'll let you, the experts, tell me which compressors we need and what recommendation you have in regards to generators.

Not knowing what a star delta starter is and based on your VSD comment – the VSD would require as large a generator on start up?

Hendra. Is this a type of generator?

We'll factor in the cost of diesel. As this is a trial we'll be looking to secure funding – the idea is to show that the systems work, not necessarily have it completely optimised at this stage. Knowing how much it would cost to achieve 500 L/s, 1000 L/s etc. is most important. We'd ideally like to put in a larger air flow rate (up to 2,500 L/s) but I assume this sky-rockets the pricing of the compressors. It's a balancing act of what we need for a long-term installation and what we need temporarily to show that this system can help us.

The VSD-type compressor is ideal for testing (so we can show the effects of different flow rates), however a combination of multiple fixed and VSD compressors is in consideration depending on pricing.

Thanks,
Fred

From: Dennis Benson <dennis.benson@atlascopco.com>
Sent: Wednesday, 7 September 2022 5:03 PM
To: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Cc: David Benbow <david.benbow@atlascopco.com>

Subject: Re: Compressors for Destratification in a Reservoir

Hi Fred. For two units we most probably look at 200 kw each or. 250 kw each for the next size if you want more air. Best with one generator per unit The VSD is easy. The fixed speed has a star delta starter We need to look for good Hendra to keep the fuel usage down for the test. Then they can transfer to electric power. It maybe best to see if the customer can one unit on available pier at site cost of diesel is expensive. Regds Dennis

---

From: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Sent: Wednesday, September 7, 2022 4:51:01 PM
To: Dennis Benson <dennis.benson@atlascopco.com>
Cc: David Benbow <david.benbow@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hey Dennis,

I've looked into some preliminary numbers for the genset power supply. I'll await your response in regards to costings for type of system we're looking for to look into it further. The person I spoke to over the phone in regards to the generator asked about the specific compressors we might be using as we would need to consider (correct me if I'm wrong) the start up power requirements of the compressor.

I looked for gensets capable of producing 400 kW, as this was roughly in the range of the compressors you've previously recommended. Should I be looking at specs larger than this? If you have any recommendations for genset power supply for the compressors and are happy to share this information, it would be most helpful.

Do you mind if I tack on some additional queries while we're in communication about these more detailed quotes?

- Would you be able to provide costing for the removal of the systems?
- Would you be able to provide information on specific maintenance considerations? I imagine this would be included in the servicing agreement but I thought I'd add it in as I hadn't specifically mentioned it.
- Are the variable flow rates of these systems able to be controlled automatically or remotely? Or are they set up for manual control only.

Thanks again for all the info!

Fred

Fred Chaaya
Project Engineer

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110 King St, Manly Vale NSW 2093 Australia

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W: wrl.unsw.edu.au

From: Dennis Benson <dennis.benson@atlascopco.com>
Sent: Tuesday, 6 September 2022 8:33 AM
To: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Cc: David Benbow <david.benbow@atlascopco.com>
Subject: Re: Compressors for Destratification in a Reservoir

Hi Fred. The oil free units are electric driven So will need gensets to supply the power   Regds Dennis

---

From: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Sent: Tuesday, September 6, 2022 8:15:41 AM
To: Dennis Benson <dennis.benson@atlascopco.com>
Cc: David Benbow <david.benbow@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hey Dennis,

As this will be a trial we're not planning on setting up any permanent power infrastructure at this stage. Likely diesel powered. Should the trial be successful, we'll look at power infrastructure to source from the grid or by means of renewables. Plenty of sun to be used out at these remote locations!

Thanks,
Fred

From: Dennis Benson <dennis.benson@atlascopco.com>
Sent: Tuesday, 6 September 2022 4:04 AM
To: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>; David Benbow <david.benbow@atlascopco.com>
Subject: Re: Compressors for Destratification in a Reservoir

Hi Fred. Dam elevation is 516 masl. So with 75 meters of water height   Will check out both 8.5. And 10 bar versions on the computer. The dam generates power but don't know if it's a continuous or peak load station. What's does the customer think of where we will get continuous power from. Regds. Dennis

---

From: Dennis Benson <dennis.benson@atlascopco.com>
Sent: Monday, September 5, 2022 2:30:42 PM
To: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>; David Benbow <david.benbow@atlascopco.com>
Subject: Re: Compressors for Destratification in a Reservoir

Hi Fred back from my cruise. Up at Mooloolaba on a conference will look at your information tonight and talk to David tomorrow. Will have to check the elevation of the dam but think 10 bar will be ok. Two smaller units are easier to start at the end of a transmission line. Regards Dennis

---

From: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Sent: Monday, September 5, 2022 1:21:26 PM
To: Dennis Benson <dennis.benson@atlascopco.com>; David Benbow <david.benbow@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hi Dennis, Hi David,

Things continue to gain traction in the world of artificial destratification. I didn't receive any specific costing information when we last spoke, so I thought I'd follow up. I understand that my vagueness with the details of the project may have been contributing!

I've spoken with out client as they've given me the green-light to share more specific information about the location of the project. We'll be looking at setting one of these systems up in Pindari Dam, up in northern NSW. Are you able to provide me some more specific costings for compressors that fit our requirements, delivery/installation fees and any servicing agreement you offer.

The information I've previously shared was specific to a single 500 L/s compressor. We're looking at the potential to put up to 1000 L/s, depending on the costing and what fits in the budget. You, the experts, know better than I how best this can be achieved. From my perspective, we want at least 500 L/s at all times, with the capability to go higher (or lower) when necessary. I see this being achieved by either:

- A single VSD compressor capable of 1,000 L/s
- Two 500 L/s compressors, one with a fixed air flow rate and the other with a VSD

If you have any recommendations on this, please let me know.

Otherwise, the compressors would need to be:

- Capable of pumping air down to a depth of 73 m of water. I'm assuming a 10 bar pressure rated compressor would be suitable, however Dennis suggested 8.5 bar would suffice. Are we at risk of exceeding the pressure rating with pipe losses given there may be km's of piping involved?
- Oil-free

If you are able to price this out before the end of the week, I would be most appreciative. More than happy to hear your recommendations on configurations and what additional costs we might need to consider (e.g. security, housing of the compressor(s), slab to mount etc.).

Please let me know if there is any other information you need from me. Happy to chat about this over the phone at any point.

Looking forward to hearing from you.

Thanks,
Fred

Fred Chaaya
Project Engineer

Water Research Laboratory
School of Civil and Environmental Engineering, UNSW Sydney
110 King St, Manly Vale NSW 2093 Australia

T: +61 2 9071 9881
M: +61 416 329 328
W: wrl.unsw.edu.au

From: Fred Chaaya
Sent: Wednesday, 10 August 2022 11:32 AM
To: Dennis Benson <dennis.benson@atlascopco.com>
Cc: David Benbow <david.benbow@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hi Dennis,

Thank you again for taking the time to talk to me about this, and I appreciate the wealth of information you've provided.

I'll be in contact as things progress on my end. For now, some pricing for your system will be very useful.

David – would you at all mind providing pricing for a few other options? Part of our design process may consider higher flow rate or pressure requirements. For example:

- 500 L/s, 10 bar VSD
- 1000 L/s 8.5 bar VSD
- 1000 L/s 10 bar VSD

Please let me know if there's any other information I can provide.

Thanks,
Fred

Fred Chaaya
Project Engineer

Water Research Laboratory
School of Civil and Environmental Engineering, UNSW Sydney
110 King St, Manly Vale NSW 2093 Australia

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W: wrl.unsw.edu.au

CRICOS Provider Code 00098G

From: Dennis Benson <dennis.benson@atlascopco.com>
Sent: Monday, 8 August 2022 12:12 PM
To: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>; David Benbow <david.benbow@atlascopco.com>
Subject: RE: Compressors for Destratification in a Reservoir

Hi Fred.
Nice to talk to you again.
Yes water is precious.
So we need to look after it.

David will give you a price for a 500l/sec 8.5 bar VSD unit.
You will need remote monitoring and control

1. Air flow through holes. Use a factor of 0.61 for a straight drilled hole.

As discussed you need to get the depth plus pipeline looses .
Have a straight pipe across the dam
Use one extra bar of pressure to get the water out of the pipe.

2.
3.

4.
Before and after dam aeration.

5.

Best regards,

Dennis Benson
Business Development Manager- Low Pressure

Atlas Copco Australia Compressor Technique

Visitor Address: 3 Bessemer St Blacktown 2148

Phone: 61 2 9621 9816 - Mobile: 61 417 15 22 12 - Fax: 61 2 9622 3409
E-mail: dennis.benson@atlascopco.com
Company Reg. No: ABN 85 620125 153

Visit Atlas Copco at: http://www.atlascopco.com
Follow us at: Facebook - LinkedIn - Twitter - YouTube - Instagram

Committed to sustainable productivity

From: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Sent: Monday, 8 August 2022 11:07 AM
To: Dennis Benson <dennis.benson@atlascopco.com>
Subject: Compressors for Destratification in a Reservoir

Hi Dennis,

Not sure if you remember our previous conversations, as we spoke a fair while ago, but I contact you previously in regards to some information on your compressors for the purposes of destratification in a large dam/reservoir.

These works are starting to gain traction. I was hoping we could have another conversation about what sort of information you would need to begin some estimates for the purchase, installation and potential maintenance of some of your compressor systems.

My contact information is in my email signature. Otherwise, feel free to reply to this email if it's easier to start a dialogue here.

Look forward to hearing from you.

Thanks,
Fred

Fred Chaaya
Project Engineer

Water Research Laboratory
School of Civil and Environmental Engineering, UNSW Sydney
110 King St, Manly Vale NSW 2093 Australia

T: +61 2 9071 9881
M: +61 416 329 328

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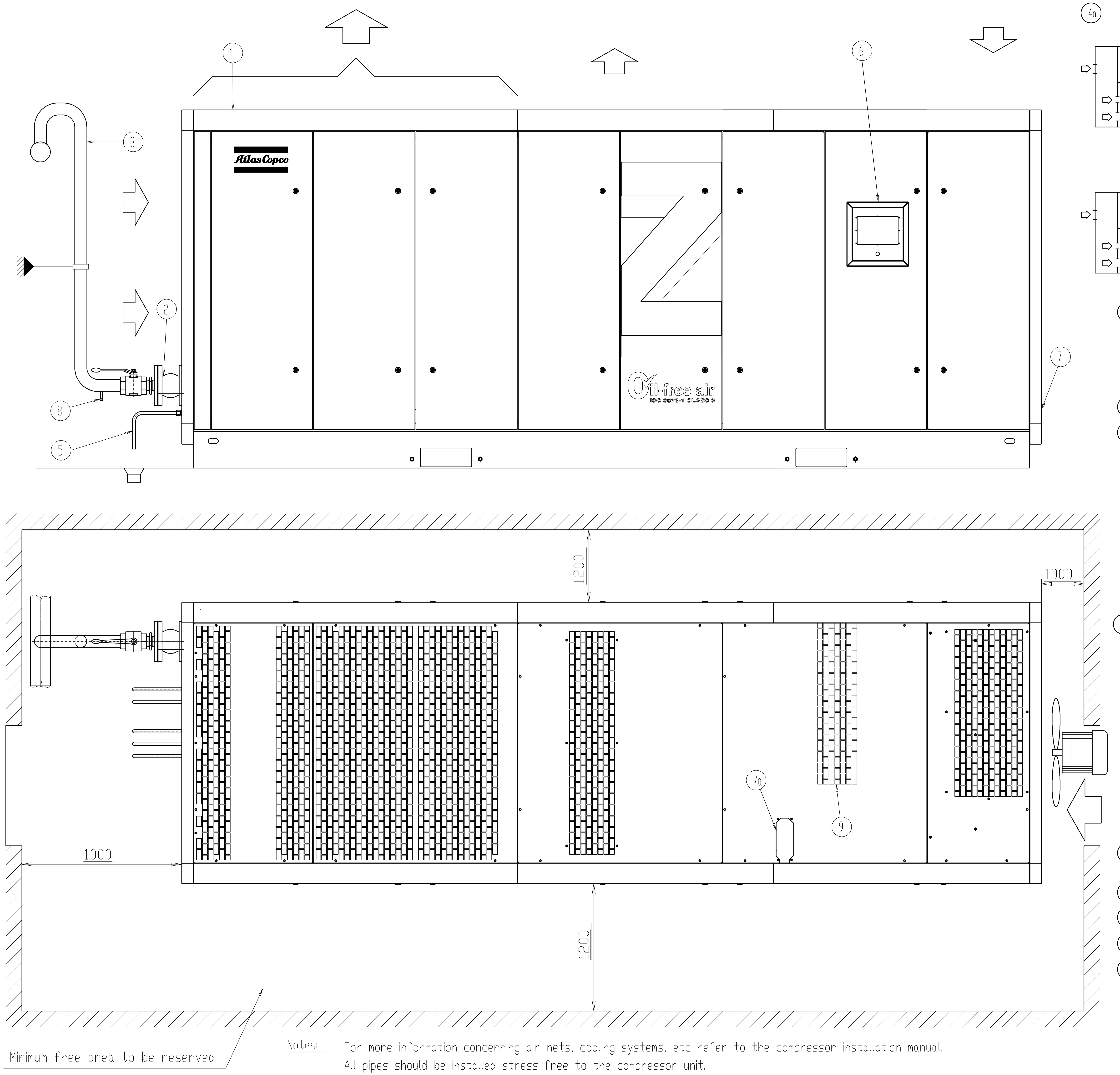
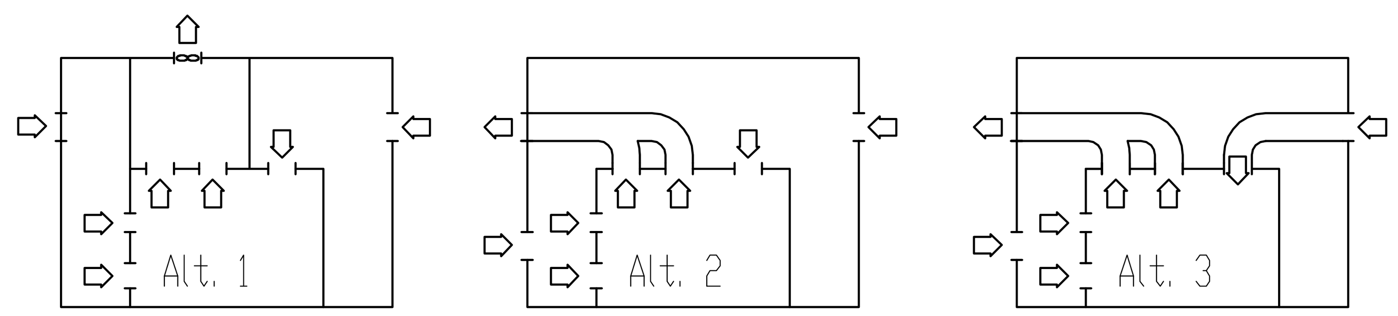
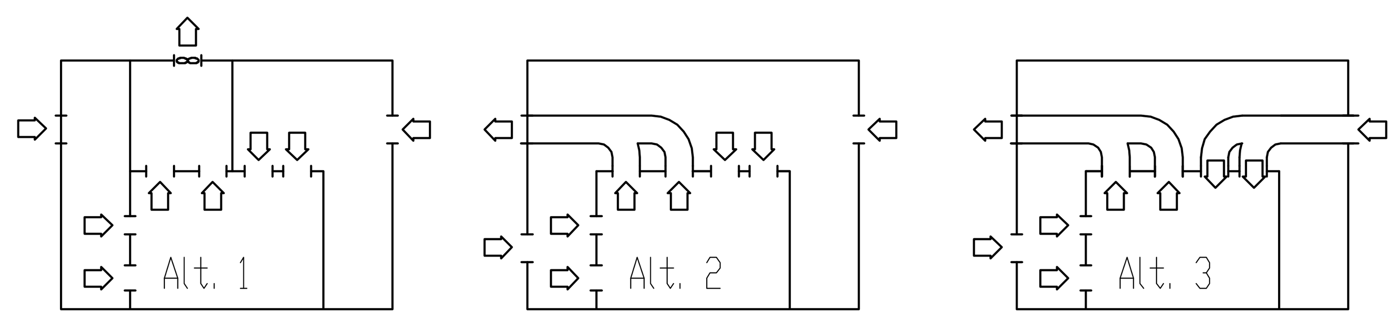


(4a) VENTILATION PROPOSAL (without option seperate air intake)



(4b) VENTILATION PROPOSAL (option seperate air intake)



MAIN COMPONENTS

1. Compressor unit:
   The unit should be installed on a level floor capable of taking the weight of the compressor (Max allowable deviation: 3mm on 1 meter).
   Recommended minimum distance between top of unit and ceiling is 1200 mm (ventilation proposal 2-3 excepted).
   Distances between units and walls stated are minimum.
2. Compressed air outlet valve with lockout / TAG OUT system.
3. Delivery pipe:
   The maximum total pipe length can be calculated from:

   $$L = \frac{\Delta P \times d^5 \times P}{450 \times Qc^{1.85}}$$

   L is the length of the pipe (m)
   ΔP is the max. allowable pressure drop (recommended 0.1 bar)
   d is the inner diameter of the pipe (mm)
   P is the absolute pressure at the compressor outlet (bar)
   Qc is the compressor FAD (l/s)

   (The connection of the compressor air delivery pipe should be made on top of the main air net pipe to minimize carry-over of possible remainder of condensate).
4. Ventilation:
   The inlet grid(s) and ventilation fan should be installed in such a way that any recirculation of cooling air to the compressor is avoided.
   The air velocity to the grid(s) has to be limited to 5 m/s.
   For alt. 2 and 3 the maximum allowable pressure drop over cooling air ducts is 30 Pa.
   The minimum air temperature at the compressor intake opening is 0°C, except option 9.
   maximum: suction air & cooling air: 40°C (For HAT version: 50°C).
   The required ventilation to limit the compressor room temperature can be calculated from: $Qv = 0.92\ N / \Delta T$
   Qv is the required ventilation capacity (m^3/s)
   N is the shaft input of the compressor (kW)
   ΔT is the compressor room temperature over the outdoor temperature (°C)
5. Drain pipes to condensate collector.
   The drain pipes must not enter in the collector.
6. Control cubicle with monitoring panel.
7. Cable power entry. (7a) Second possibility only for VSD units
8. Drain valve
9. Extra inlet grating only for units with option separate air intake and/or prefilter min temp -20°C

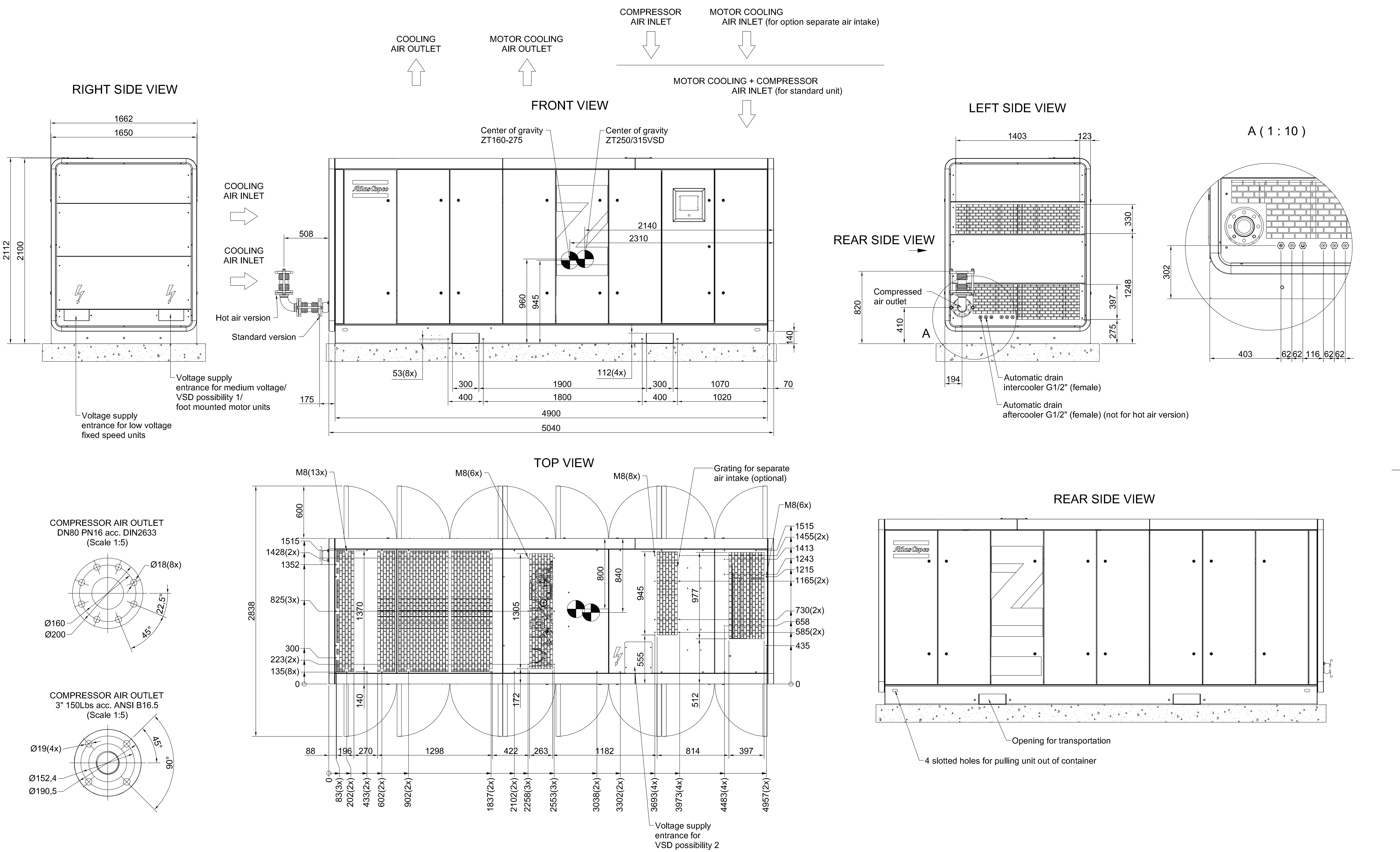
ZT160-275 , ZT250/315VSD

Notes:
- For more information concerning air nets, cooling systems, etc refer to the compressor installation manual.
  All pipes should be installed stress free to the compressor unit.
- For dimensions and air flow directions refer to the APC dimension drawings.
- Instructions for cable section etc. see 9823 3239 00 for fixed speed , see 9823 3240 00 for VSD
- Instructions for IT-TT nets see 9823 0071 00, 9823 0072 00

Note	Posi-tion	Modified from	Date	Intr./Appd.
03		Drawing updated and converted in autocad.	2013-01-23	AIR13809

Parent 3D Model	Ed. Version 3D		

Tolerances,if not indicated,according to: ATLAS COPCO STANDARD Class					
Name	INSTAL. PROPOSAL			Secrecy Class 1102 K/ 3	
Material	NOT APPLICABLE				
Treatment	Untreated			ACD	
Atlas Copco	Scale -:-	Family	A1	Compare	Drawing owner AIF
	Drawn by cwalekar	Blank nr.		Replaces X106 37S 426	
STATUS	Version Drwg 03	Blank wt. 0 kg	Fini wt. 0 kg	Designation	Sheet ( ) 01 02
Approved	Des checked	Prod checked	Approved	Date 2012-11-28	9823 3249 00



	NET MASS. STANDARD KG	NET MASS. NO MOTOR KG
ZT160	5150 (*)	3900
ZT200	5250 (*)	3900
ZT250	5300 (*)	3900
ZT275	5400 (*)	3900
ZT250/315VSD	5750 (*)	-

(*) 700kg is to be added in case of high ambient temperature unit, or oversized/medium voltage motor

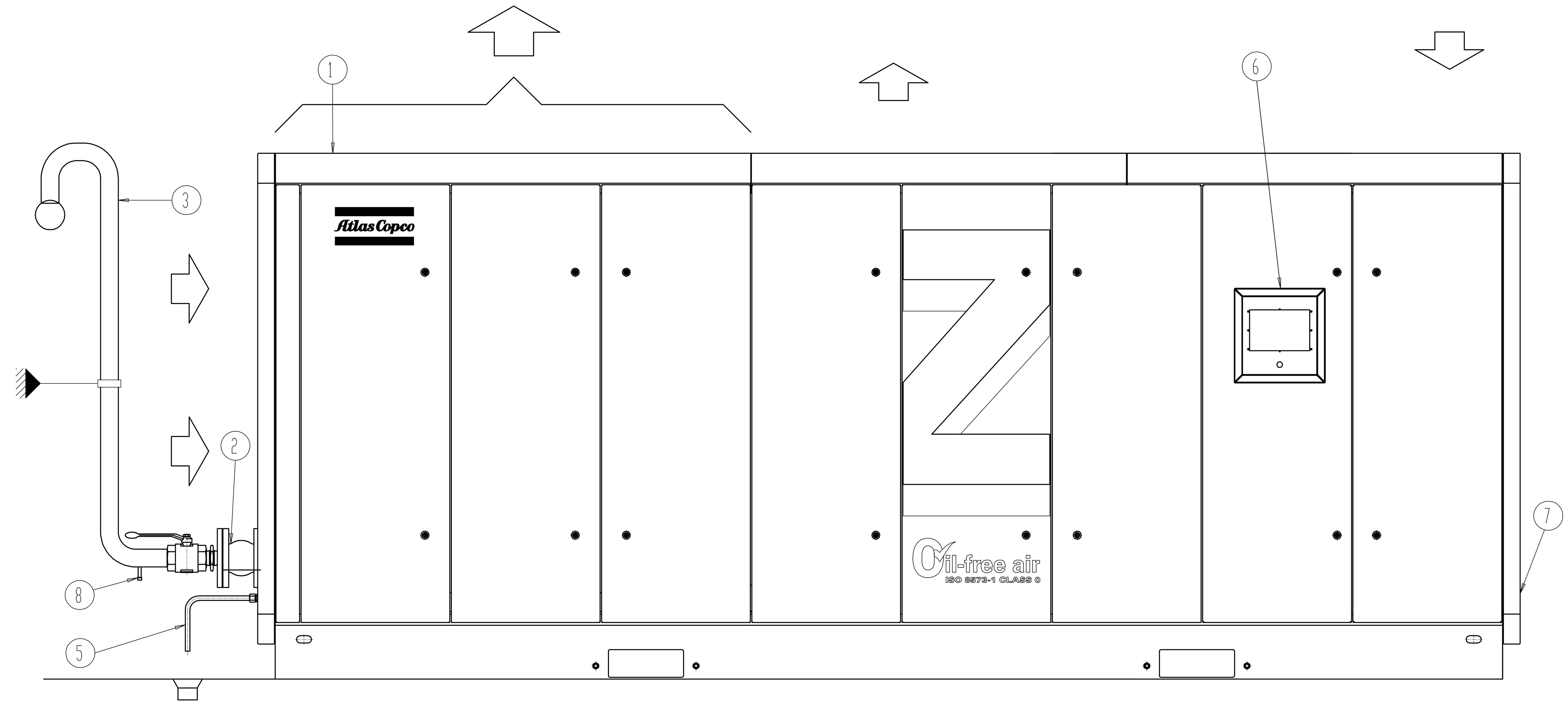
ZT 160-275 PACK STANDARD/HOT AIR/SEPERATE AIR INTAKE
ZT 250-315VSD PACK STANDARD/HOT AIR/SEPERATE AIR INTAKE

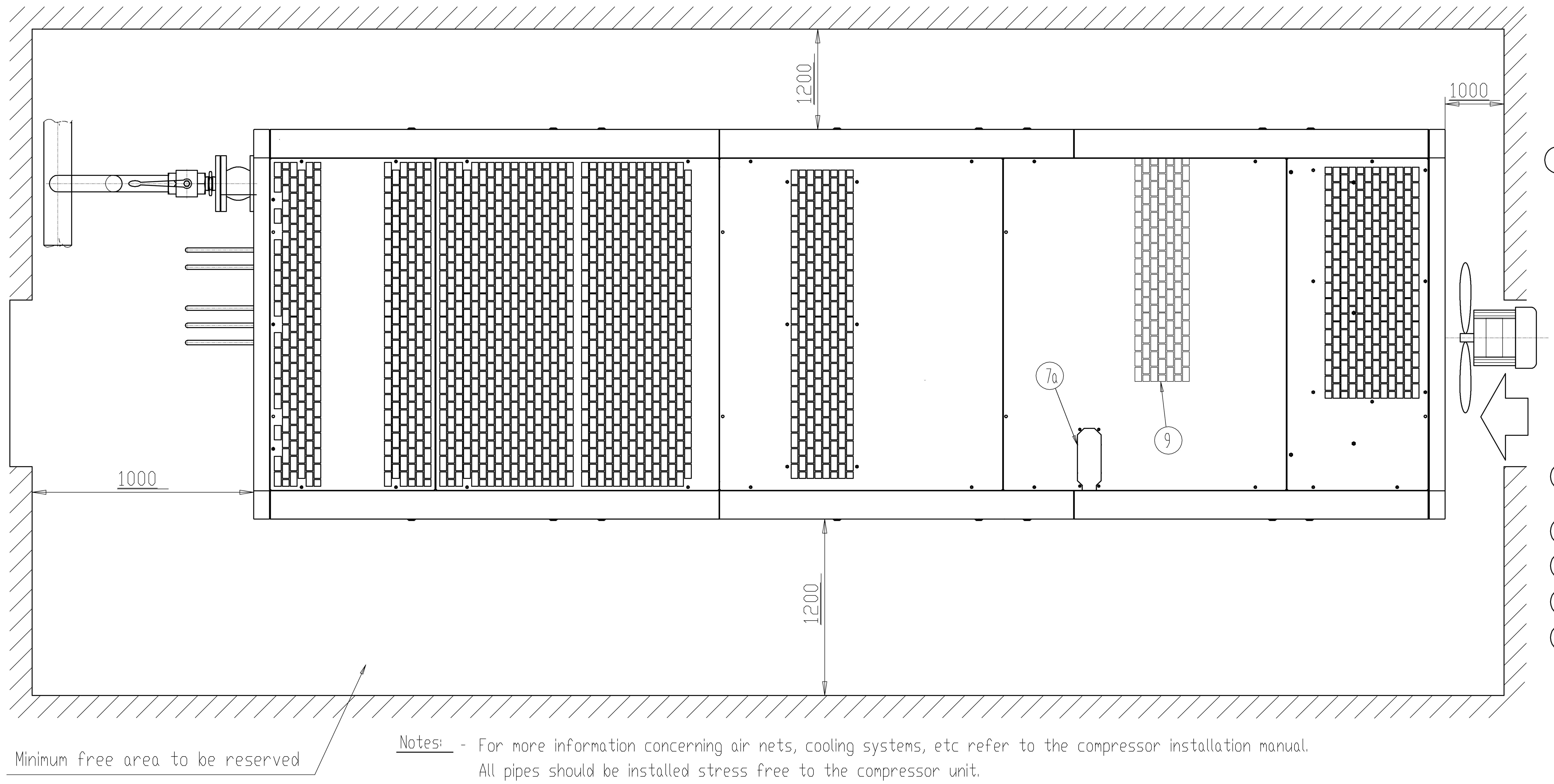
All materials supplied are in compliance with the requirements of the List of Prohibited Substances

Tolerances if not indicated according to: ATLAS COPCO STANDARD Class

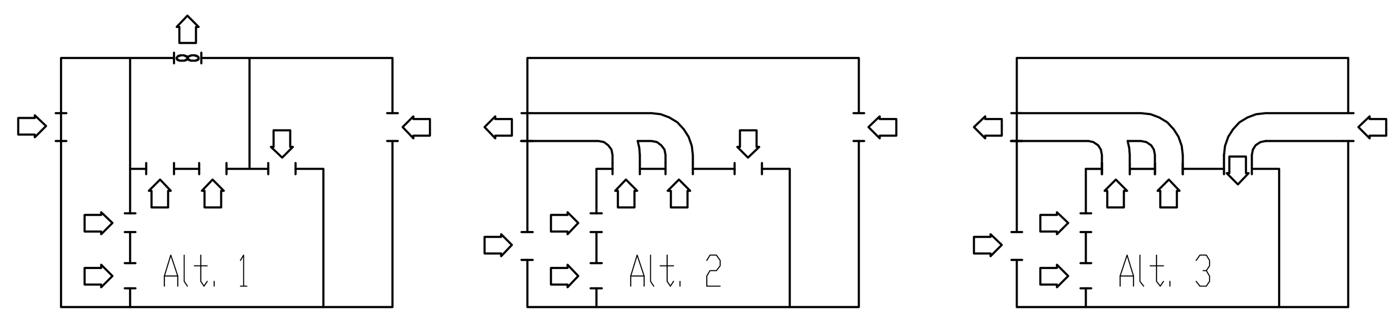
Name: DIMENS. DRWG
Material: NOT APPLICABLE
Treatment: Not Applicable
Scale: 1:20
Drawn by: AIR12989
Version Dwg: 05
Replaces: X106 37S 169
Drawing owner: AIF
Designation: 9823 3261 00
Date: 2014-07-11
Approved

Note	Position	Modified from	Date	Intr./Appd.
05		Weights corrected	2014-07-15	

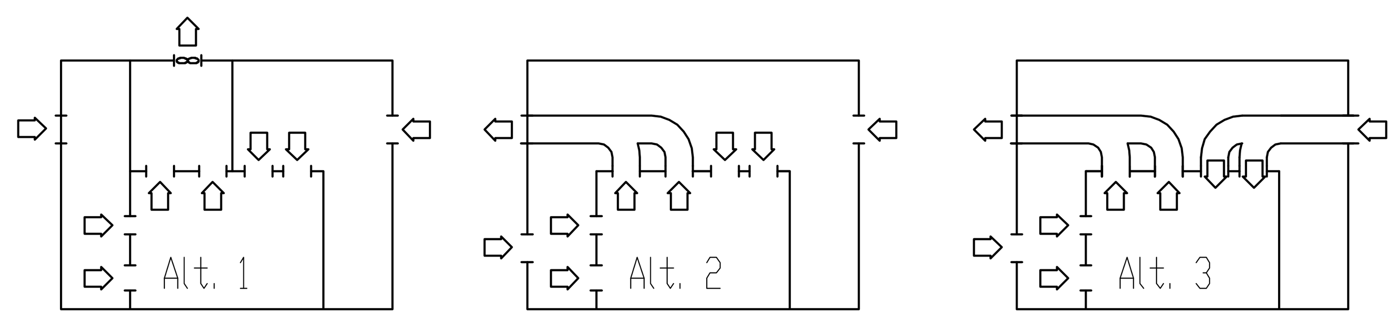




4a VENTILATION PROPOSAL (without option seperate air intake)



4b VENTILATION PROPOSAL (option seperate air intake)



MAIN COMPONENTS

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   The unit should be installed on a level floor capable of taking the weight of the compressor (Max allowable deviation: 3mm on 1 meter).
   Recommended minimum distance between top of unit and ceiling is 1200 mm (ventilation proposal 2-3 excepted).
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2. Compressed air outlet valve with lockout / TAG OUT system.
3. Delivery pipe:
   The maximum total pipe length can be calculated from:

   $$L = \frac{\Delta P \times d^5 \times P}{450 \times Qc^{1.85}}$$

   L is the length of the pipe (m)
   ΔP is the max. allowable pressure drop (recommended 0.1 bar)
   d is the inner diameter of the pipe (mm)
   P is the absolute pressure at the compressor outlet (bar)
   Qc is the compressor FAD (l/s)

   (The connection of the compressor air delivery pipe should be made on top of the main air net pipe to minimize carry-over of possible remainder of condensate).
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   The inlet grid(s) and ventilation fan should be installed in such a way that any recirculation of cooling air to the compressor is avoided.
   The air velocity to the grid(s) has to be limited to 5 m/s.
   For alt. 2 and 3 the maximum allowable pressure drop over cooling air ducts is 30 Pa.
   The minimum air temperature at the compressor intake opening is 0°C, except option 9.
   maximum: suction air & cooling air: 40°C (For HAT version: 50°C).
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ZT160-275 , ZT250/315VSD

Notes:
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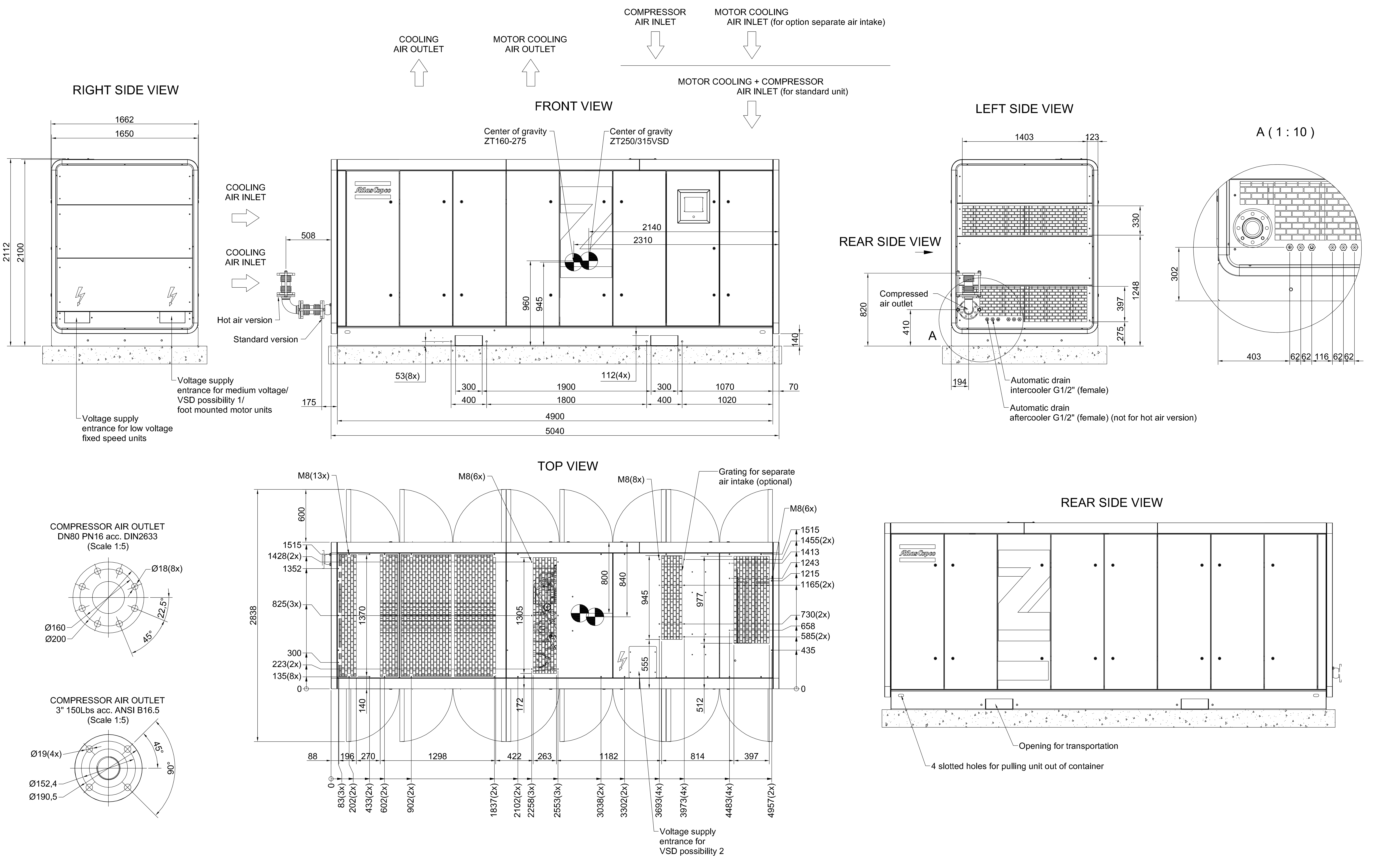
- For dimensions and air flow directions refer to the APC dimension drawings.
- Instructions for cable section etc. see 9823 3239 00 for fixed speed , see 9823 3240 00 for VSD
- Instructions for IT-TT nets see 9823 0071 00, 9823 0072 00

Note	Posi-tion	Modified from	Date	Intr./Appd.
03		Drawing updated and converted in autocad.	2013-01-23	

Tolerances,if not indicated,according to: ATLAS COPCO STANDARD Class			
Name	INSTAL. PROPOSAL	Secrecy Class	1102 K/ 3
Material	NOT APPLICABLE		ACD
Treatment	Untreated		
Scale -:-	Family	A1	Compare
Drawn by cwalekar	Blank nr.		Replaces X106 37S 426
Version Drwg 03	Blank wt. 0 kg	Fini wt. 0 kg	Designation Sheet ( ) 01 02
Des checked	Prod checked	Approved	Date 2012-11-28
STATUS: Approved	Drawing owner: AIF	Parent 3D Model	Ed. Version 3D

9823 3249 00



	NET MASS. STANDARD KG	NET MASS. NO MOTOR KG
ZT160	5150 (*)	3900
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ZT275	5400 (*)	3900
ZT250/315VSD	5750 (*)	-

(*) 700kg is to be added in case of high ambient temperature unit, or oversized/medium voltage motor

ZT 160-275 PACK STANDARD/HOT AIR/SEPERATE AIR INTAKE
ZT 250-315VSD PACK STANDARD/HOT AIR/SEPERATE AIR INTAKE

All materials supplied are in compliance with the requirements of the List of Prohibited Substances

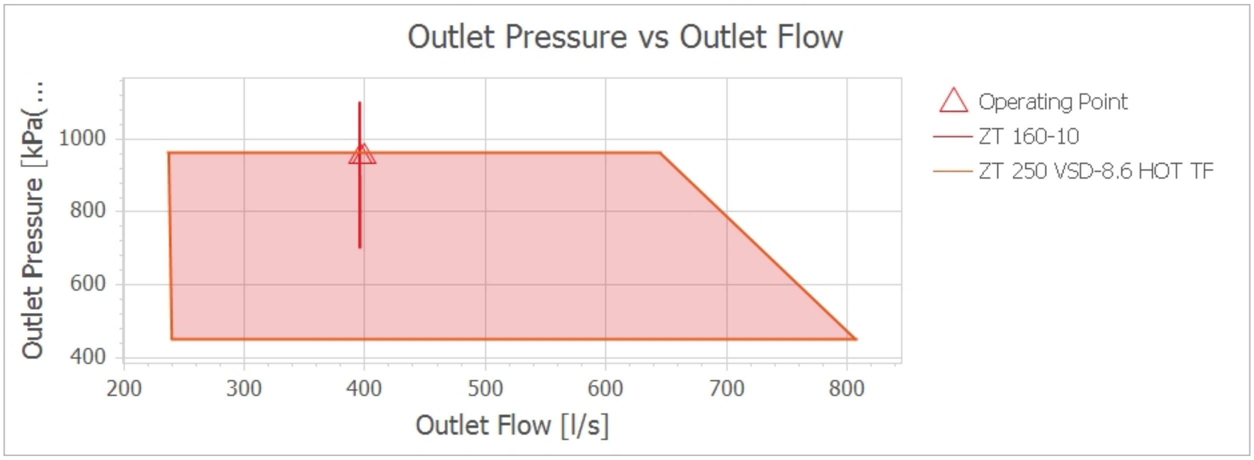
Tolerances if not indicated according to: ATLAS COPCO STANDARD Class

Name: DIMENS. DRWG
Material: NOT APPLICABLE
Treatment: Not Applicable
Secrecy Class: 1102 K/ 3 ACD
Scale: 1:20
Drawn by: AIR12989
Replaces: X106 37S 169
Version Dwg: 05
Blank wt. 0 kg Fini wt. 0 kg
Drawing owner: AIF
Sheet 01 02
Approved
Date: 2014-07-11
9823 3261 00

Parent 3D Model | Ed. Version 3D

Note	Position	Modified from	Date	Intr./Appd.
05		Weights corrected	2014-07-15	

CONFIDENTIAL:


Outlet Pressure vs Outlet Flow
Outlet Pressure [kPa(...
1000
800
600
400
200
300
400
500
600
700
800
Outlet Flow [l/s]
Operating Point
ZT 160-10
ZT 250 VSD-8.6 HOT TF

ZT 110-275

ATLAS COPCO OIL-FREE ROTARY SCREW AIR COMPRESSOR

The Atlas Copco ZT 110-275 powers your production with ultimate reliability and efficiency under the harshest conditions. The first air compressors in the world to be certified CLASS 0 according to ISO 8573-1 edition 2, 2010; they ensure completely oil-free air to protect your process and end products. .

Your benefits

Excellent reliability

For over 50 years, Z compressors stand for durability and reliability. They incorporate Atlas Copco's proven screw technology, stainless steel coolers, AGMA A5/DIN 5 gears and state-of-the art electrical drive systems, all of which contribute to the high reliability of your equipment and your superior productivity.

Certified 100% oil-free

ZT 110-275 compressors provide you with 100% pure, clean air that complies with ISO 8573-1 CLASS 0 (2010) certification. CLASS 0 means zero risk of contamination; zero risk of damaged or unsafe products; zero risk of losses from operational downtime and zero risk of damaging your company's hard-won professional reputation.

Maximum energy savings

Atlas Copco's unique and time proven rotor coating ensures high efficiency over the compressors lifetime. The state-of-the art air compressor element is powered by a high-efficiency electric motor, contributing to maximum compressor package efficiency and consequently lower energy costs.

Easy installation

The integrated design of the ZT 110-275 compressor includes internal piping, coolers, motor, lubrication and control system: all supplied as a ready-to-use package. Installation is fault-free, commissioning time is low and no external instrument air is required.

Advanced control and monitoring

To maximize efficiency and reliability, the Elektronikon® controls the main drive motor and regulates system pressure within a predefined and narrow pressure band.

Ultimate Reliability, Efficiency and Quality

The superior Oil Free screw Element

- Reliability
  - Superior Teflon rotor coating
  - Balance piston on high pressure stage
  - Four high precision ball bearings per stage (8 bearings in total)
- Efficiency
  - Superior rotor coating with running in capabilities
  - Liquid cooled element jackets
  - Atlas Copco's proprietary asymmetric rotor profile
- Air Quality
  - Certified 100% Oil-free air
  - Floating ring stainless steel Air seals
  - Wind back type oil seal
  - Vent hole separating air and oil-seals

The reliable element intake protection

- Reliability
    - High efficiency filter
    - Pressure differential protection
    - Large dust holding capacity
- Efficiency
    - Low pressure drop – 10mbar
- Air Quality
    - 99.5% efficiency at 1 micron particle size

Inlet throttle valve

- Reliability
    - No external power supply required
    - Mechanical interlocked throttle and blow of function
- Efficiency
    - Very low unload power
    - Very low pressure drop

Main drive motor

- Reliability
  - IP23-IP55 TEFC motors
- Efficiency
  - High efficiency IE3 / NEMA premium as standard

The reliable and efficient air cooling system

- Reliability
  - Stainless steel pre-cooler
  - Stress free connections
- Efficiency
  - Compact integrated design guaranteeing extreme low pressure drop
  - Aluminium brazed plate heat exchangers result in very low cooler approach temperatures
  - High efficiency radial fans
- Air Quality
  - Low water load to dryers

Control and monitoring system

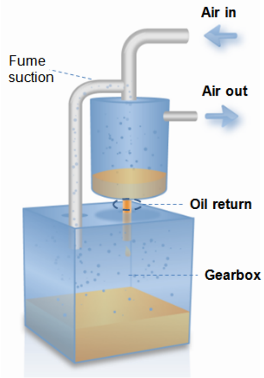
- Reliability
  - Dedicated compressor controller
  - Full control and monitoring > 100.000 references in the market
  - Protection – service and shutdown warnings
  - External communication – possibility to remotely monitor and control

- Efficiency
    - Load/ Unload regulation
    - DSS: Delayed Second Stop function will stop the motor whenever possible
    - Full compatibility with ES systems (Energy savers) and connectivity

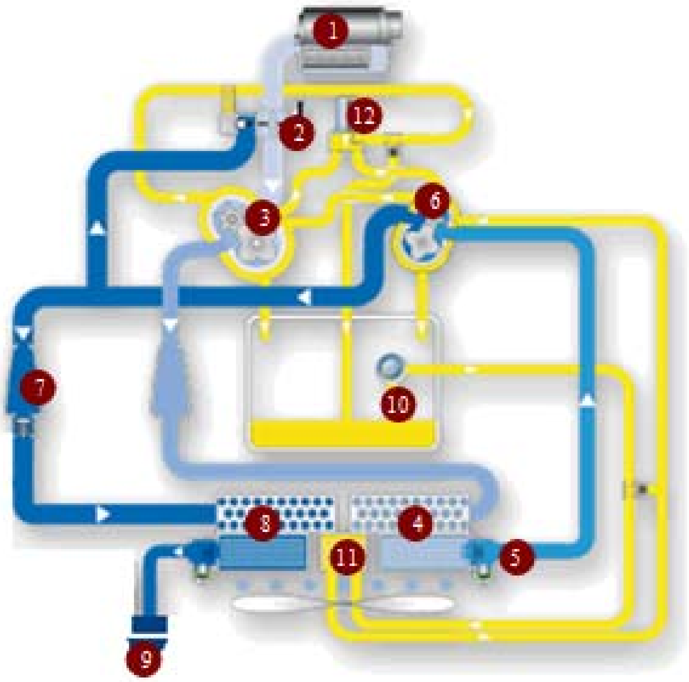
Up to 31 languages are supported by the Elektronikon® control!

Patented gearbox breather system

- Reliability
    - No external power supply required
- Air Quality
    - No oil fumes inside canopy
    - Oil is separated and flows back to gear casing



Working principle for ZT 110-275



The air (blue) is drawn into the compressor through the inlet filter (1) where the air is cleaned. Then it passes through the throttle valve (2) with integrated blow off valve that takes care of the load unload regulation.

In the first compression stage (3) the air pressure is raised to the intermediate pressure after which the air is cooled down in the intercooler (4). After the intercooler the air passes through a moisture separation system (5) before entering the high pressure stage (6).

In the high pressure stage the pressure is brought to the final pressure. The air at the outlet of the high pressure stage goes via the pulsation damper with integrated check valve (7) to the aftercooler (8) where it is cooled down and moisture is separated and evacuated.

The compressed air leaves the compressor through the outlet connection flange (9).

The yellow flow is the oil path within the compressor, where the oil pump (10) sucks oil from the oil sump and pumps it through the oil cooler (11) and the high efficiency filter (12) giving cool clean oil to the bearings, the gears and the compressor’s element jackets.

Standard scope of the supply

- Sturdy base frame with integrated forklift slots
- Sound insulated sheet metal canopy

Air Circuit

- Air inlet silencer
- Inlet Air filter
- Inlet throttle valve with integrated blow off valve and blow off silencer
- Low pressure element
- High pressure element
- Aluminum brazed plate air-cooled intercooler and aftercooler with stainless steel pre-cooler
- Water separators with moisture trap
- Electronic drains
- Pressure safety valves
- Pulsation damper
- Check valve
- DIN or ANSI connecting flanges.

Drive system and oil system

- IP23-IP55 TEFC main drive motor
- Flexible rubber coupling
- Coupling housing
- Integrated positive displacement oil pump
- Oil level sight glass
- High efficiency oil filter
- Aluminium brazed plate oil cooler
- Oil pressure regulating valve
- Gearbox breather system
- Gear box with precision step up gears

Control & monitoring

- Elektronikon® microprocessor controller
- Star Delta starting system with overload protection
- Pressure and temperature sensors
- Solenoid control for throttle valve

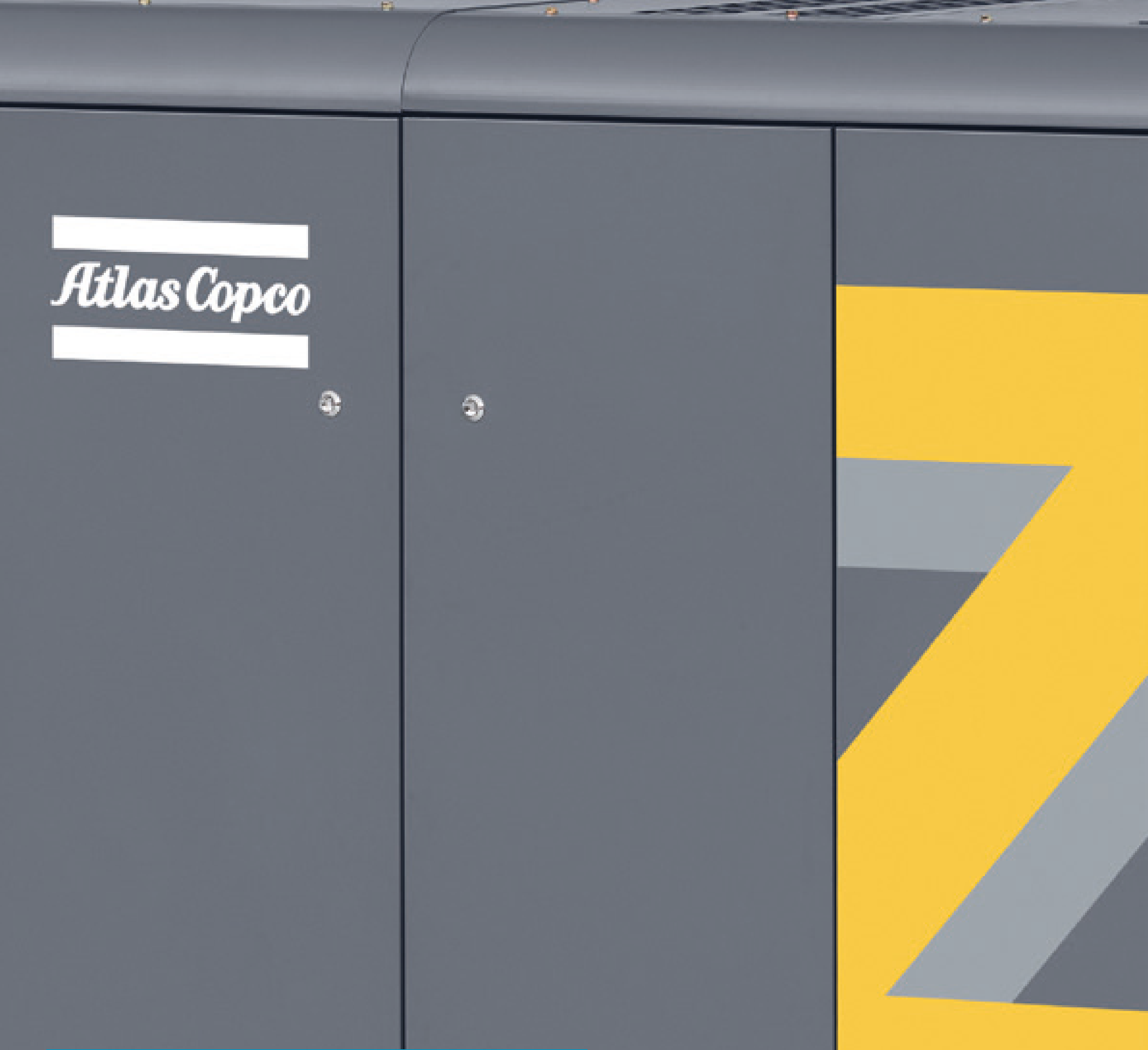
Features and benefits

- Certified 100% oil-free air
  - Peace of mind for your products and processes
- High efficiency motor IE3 / NEMA premium Efficiency
  - Energy saving
- Aluminium brazed plate coolers with stainless steel pre-cooler
  - High corrosion resistance and reliability with excellent heat transfer characteristics.
  - Perfect inter-cooling gives energy savings – reducing running costs.
- Improved element design with smallest rotor clearances
  - Improved efficiency – lower running costs
- Complete package with all inter-connecting piping
  - Easy and quick start up saving time and having no hidden costs
- Quiet operation
  - Great flexibility in installations that are noise sensitive
- IP 23-IP55 TEFC rated motor
  - Excellent dust protection
- State of the art electronic controller
  - Connectivity
  - Compatible with ES multi compressor control system

Oil-free rotary screw compressors

ZR/ZT 110-275 (FF) & ZR/ZT 132-315 VSD (FF)

Atlas Copco



Setting the standard in energy efficiency, safety and reliability

The shortest route to superior productivity is to minimize operational cost while maintaining an uninterrupted supply of the right quality of air. The Atlas Copco Z compressor series is focused on effectively saving energy, ensuring product safety –only oil-free machines exclude contamination risks for 100% – and guaranteeing the utmost reliability around the clock. And not just today, but day after day, year after year, with minimal maintenance cost, few service interventions and long overhaul intervals.

Highest reliability

For 60 years, Atlas Copco Z compressors have set the benchmark for durability. They are built using long-standing internal engineering practices, and are designed and manufactured according to ISO 9001, ISO 14001, ISO 22000 & OHSAS 18001. The high-end ZR/ZT uses time-proven state-of-the-art screw technology, cooling and pulsation dampers and provides you with the highest reliability.

100% oil-free compressed air

The ZR/ZT offers you 100% pure, clean air that complies with ISO 8573-1 CLASS 0 (2010) certification. This means zero risk of contamination; zero risk of damaged products; zero risk of losses from operational downtime; and zero risk of damaging your company's hard-won professional reputation.

Maximum energy efficiency

The ZR/ZT's superior oil-free screw elements provide the optimum combination of high Free Air Delivery (FAD) with the lowest energy consumption. Ample sized cooling, low pressure drops and an extremely efficient drive train result in the highest compressor package efficiency.

The most complete package

With the ZR/ZT compressor, Atlas Copco provides a superior solution without hidden costs. The totally integrated, ready-to-use package includes internal piping, coolers, motor, lubrication and control system. The Full Feature version even integrates an IMD adsorption dryer for an impeccable end product. Installation is fault-free, commissioning time is low and no external instrument air is required. You simply plug and run.

Global presence - local service

Our aftermarket product portfolio is designed to add maximum value for our customers by ensuring the optimum availability and reliability of their compressed air equipment with the lowest possible operating costs. We deliver this complete service guarantee through our extensive service organization, maintaining our position as leader in compressed air.

100% certified oil-free air

Atlas Copco is renowned for designing and manufacturing some of the most durable oil-free screw compressors. The ZR/ZT high-end rotary screw compressor comes out of this strong tradition. Ideal for industries where high-quality oil-free air is key, the ZR/ZT offers the highest reliability and safety in combination with low energy costs.

Food & beverage

- 100% pure, clean, oil-free air for all kinds of applications (e.g. fermentation, packaging, aeration, transportation, filling & capping, cleaning, instrument air).
- ISO 8573-1 CLASS 0 (2010) certification to avoid compromising the purity of your end product and ensure zero risk of contamination.

Textiles

- Easy and quick installation.
- A completely, fully integrated, ready-to-use solution.

Oil & gas

- Years of experience in providing compressed air for the oil & gas industry.
- 100% oil-free compressed air for control/instrument air or buffer air.
- Strong global support network to provide 24/7 assistance.

Power plants

- Ideal for applications such as flue gas desulphurization, oxidation air, and fluidized beds.
- Continuous operation.

Class 0: the industry standard

Oil-free air is used in all kinds of industries where air quality is paramount for the end product and production process. These applications include food and beverage, pharmaceutical, chemical and petrochemical, semiconductor and electronics, the medical sector, automotive paint spraying, textile and many more. In these critical environments, contamination by even the smallest quantities of oil can result in costly production downtime and product spoilage.

First in oil-free air technology

Over the past sixty years Atlas Copco has pioneered the development of oil-free air technology, resulting in a range of air compressors and blowers that provide 100% pure, clean air. Through continuous research and development, Atlas Copco achieved a new milestone, setting the standard for air purity as the first manufacturer to be awarded CLASS 0 certification.

Eliminating any risk

As the industry leader committed to meeting the needs of the most demanding customers, Atlas Copco requested the renowned TÜV institute to type-test its range of oil-free compressors and blowers. Using the most rigorous testing methodologies available, all possible oil forms were measured across a range of temperatures and pressures. The TÜV found no traces of oil at all in the output air stream.

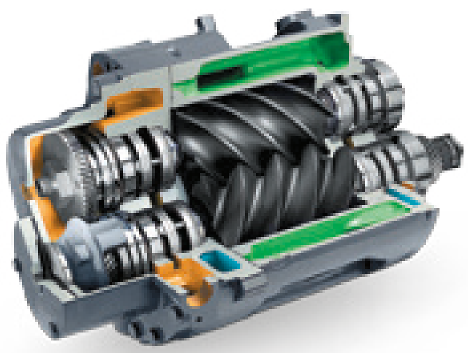
CLASS	Concentration total oil (aerosol, liquid, vapor) mg/m³
0	**As specified by the equipment user or supplier and more stringent than class 1**
1	< 0.01
2	< 0.1
3	< 1
4	< 5

Current ISO 8573-1 (2010) classes (the five main classes and the associated maximum concentration in total oil content).

Proven Z technology: ZR (water-cooled) version

1
Throttle valve with load/unload regulation

- No external air supply required.
- Mechanical interlock of inlet and blow-off valve.
- Low unload power.



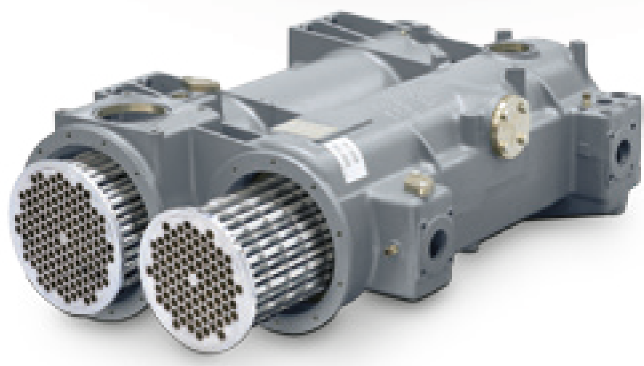
2
World-class oil-free compression element

- Unique Z seal design guarantees 100% certified oil-free air.
- Atlas Copco superior rotor coating for high efficiency and durability.
- Cooling jackets.

3
High efficiency coolers and water separator

- Corrosion resistant stainless steel tubing*.
- Highly reliable robot welding; no leakages*.
- Aluminium star insert increases heat transfer*.
- Water separator with labyrinth design to efficiently separate the condensate from the compressed air.
- Low moisture carry-over protects downstream equipment.

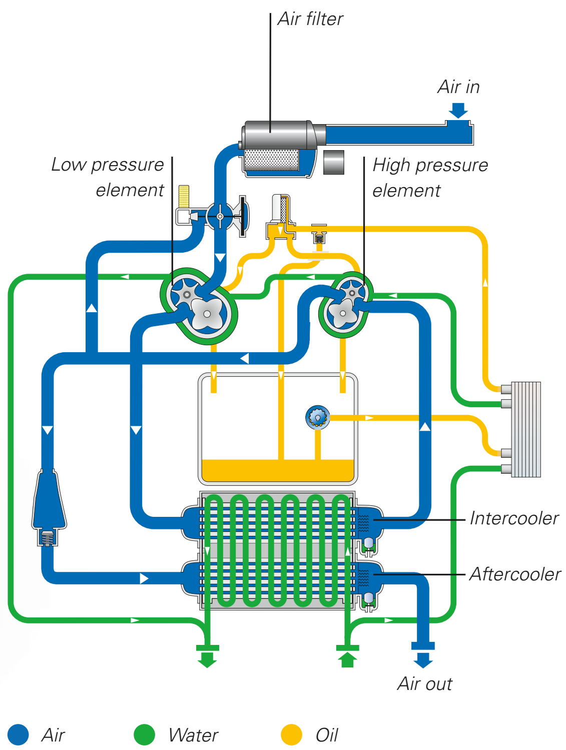
** Only for ZR water-cooled versions.*



4 Motor

- IP55 TEFC protection against dust and humidity.
- High efficiency fixed speed IE3 motor (equal to NEMA Premium).

Water-cooled ZR Pack



5 Advanced Elektronikon®

- Large 5.7” sized color display available in 31 languages for optimal ease of use.
- Controls the main drive motor and regulates system pressure to maximize energy efficiency.

A complete Full Feature package: ZT (air-cooled) version

1

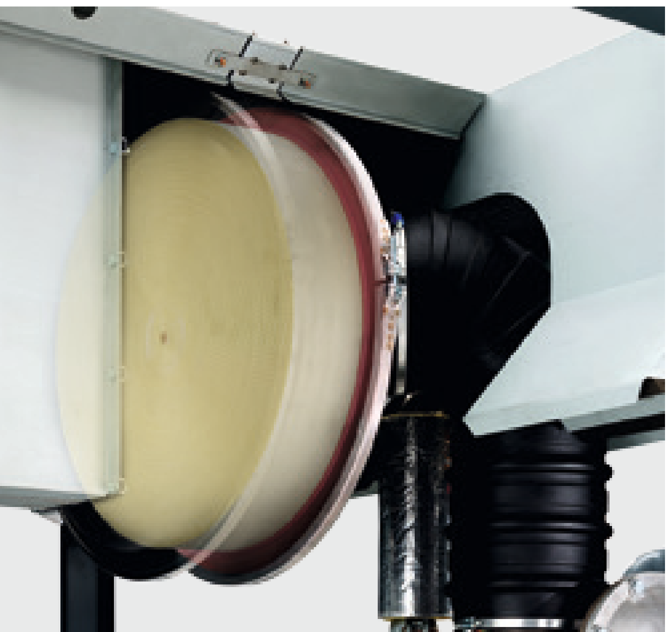
Silenced canopy

- Base frame with forklift slot.
- Fully packaged, easy to install.
- Easy ducting.

2

Efficient intake air filtration

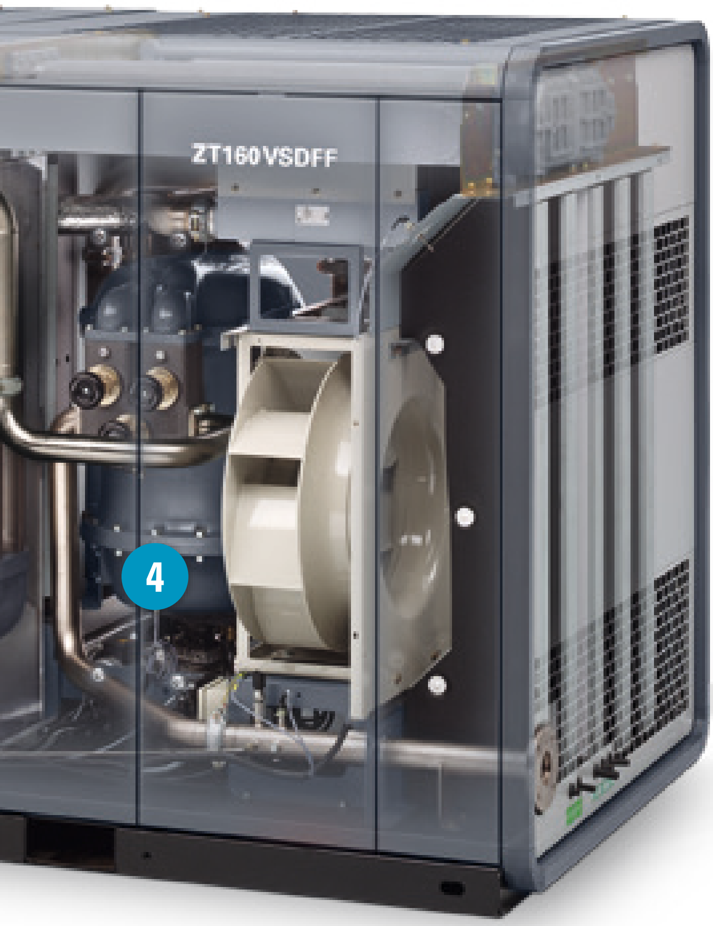
- 2-stage dust removal system (99.9% for 3 micron).
- Low pressure drop.
- Efficient protection of the compressor.
- Minimum intake losses.



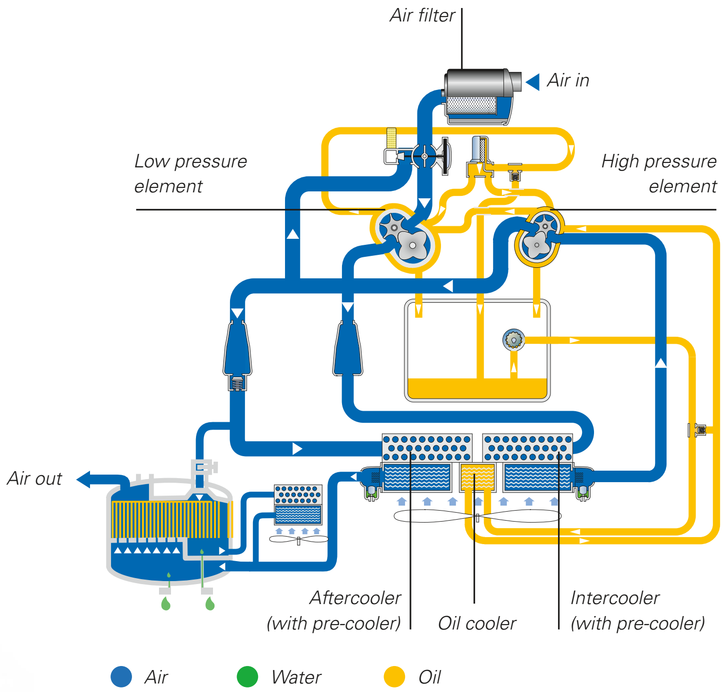
3

High-efficiency motor + VSD

- TEFC IP55 motor protects against dust and chemicals.
- Continuous operation under severe ambient temperature conditions.
- Full regulation between 30 to 100% of the maximum capacity.



Air-cooled ZT Full Feature



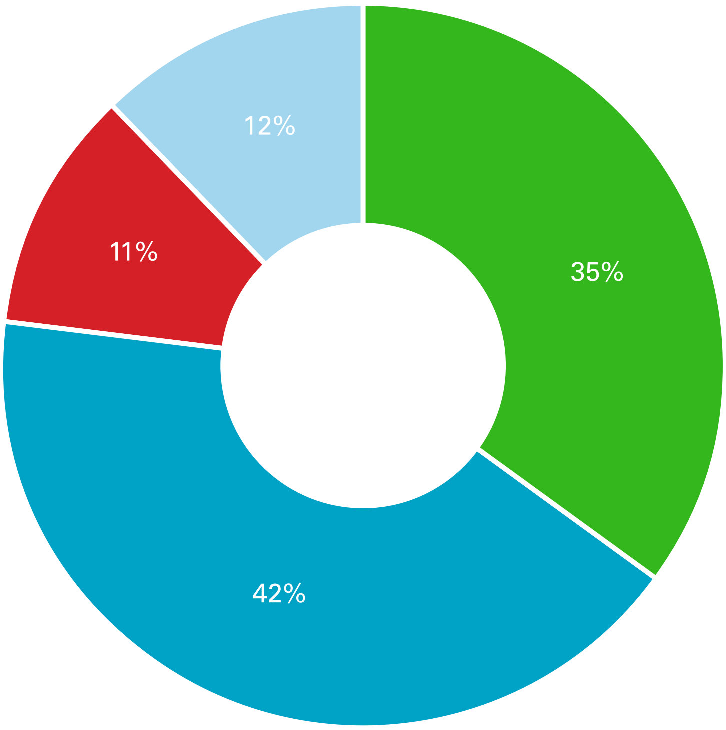
4

Full Feature: IMD adsorption dryer

- Eliminates the moisture before it enters the air net.
- Ensuring a reliable process and a top quality end product.
- No external energy is needed to dry the air, resulting in high energy savings and no compressed air losses.
- Minimal pressure drop.

VSD: driving down energy costs

Over 80% of a compressor's lifecycle cost is taken up by the energy it consumes. Moreover, the generation of compressed air can account for more than 40% of a plant's total electricity bill. To cut your energy costs, Atlas Copco pioneered Variable Speed Drive (VSD) technology in the compressed air industry. VSD leads to major energy savings, while protecting the environment for future generations. Thanks to continual investments in this technology, Atlas Copco offers the widest range of integrated VSD compressors on the market.



Energy savings of up to 35%

Atlas Copco's VSD technology closely follows the air demand by automatically adjusting the motor speed. This results in large energy savings of up to 35%. The Life Cycle Cost of a compressor can be cut by an average of 22%. In addition, lowered system pressure with VSD minimizes energy use across your production dramatically.

Total compressor lifecycle cost

- *Energy*
- *Investment*
- *Energy savings with VSD*
- *Maintenance*

What is unique about the integrated Atlas Copco VSD?

1. The Elektronikon® controls both the compressor and the integrated converter, ensuring maximum machine safety within parameters.
2. Flexible pressure selection from 4 to 10.4 bar with VSD reduces electricity costs.
3. Specific converter and motor design (with protected bearings) for the highest efficiency across the speed range.
4. Electric motor specifically designed for low operating speeds with clear attention to motor cooling and compressor cooling requirements.
5. All Atlas Copco VSD compressors are EMC tested and certified. Compressor operation does not influence external sources and vice versa.
6. Mechanical enhancements ensure that all components operate below critical vibration levels throughout the entire compressor speed range.
7. A highly efficient frequency converter in a cubicle ensures stable operation in high ambient temperatures up to 50°C/122°F (standard up to 40°C/104°F).
8. No 'speed windows' that can jeopardize the energy savings and the stable net pressure. Turndown capability of the compressor is maximized to 70-75%.
9. Net pressure band is maintained within 0.10 bar, 1.5 psi.

Monitoring and control: how to get the most from the least

The Elektronikon® unit controller is specially designed to maximize the performance of your compressors and air treatment equipment under a variety of conditions. Our solutions provide you with key benefits such as increased energy efficiency, lower energy consumption, reduced maintenance times and less stress... less stress for both you and your entire air system.

Intelligence is part of the package

- High resolution color display gives you an easy to understand readout of the equipment's running conditions.
- Clear icons and intuitive navigation provides you fast access to all of the important settings and data.
- Monitoring of the equipment running conditions and maintenance status; bringing this information to your attention when needed.
- Operation of the equipment to deliver specifically and reliably to your compressed air needs.
- Built-in remote control and notifications functions provided as standard, including simple to use Ethernet based communication.
- Support for 31 different languages, including character based languages.

Online & mobile monitoring

Monitor your compressors over the Ethernet with the new Elektronikon® controller. Monitoring features include warning indications, compressor shut-down and maintenance scheduling. An Atlas Copco App is available for iPhone/Android phones as well as iPad and Android tablets. It allows fingertip monitoring of your compressed air system through your own secured network.

SMARTLINK*: Data monitoring program

- A remote monitoring system that helps you optimize your compressed air system and save you energy and cost.
- It offers you a complete insight in your compressed air network and anticipates on potential problems by warning you up-front.

**Please contact your local sales representative for more information.*

Protecting your production

Untreated compressed air contains moisture and possibly dirt particles that can damage your air system and contaminate your end product. The resulting maintenance costs far exceed air treatment costs. Atlas Copco believes in effective prevention and provides a complete range of air treatment solutions to protect investments, equipment, production processes and end products.

Increase production reliability

Low quality air heightens the risk of corrosion, which can lower the life span of production equipment. The air treatment solutions produce clean air that enhances your system's reliability, avoiding costly downtime and production delays.

Safeguard production quality

Compressed air coming into contact with your final products should not affect their quality. Atlas Copco provides clean, dry air to protect your production and reputation in the market.

Supreme energy and cost savings

Atlas Copco's quality air solutions stand for substantial energy savings all day, every day. Taking technology to a new level, these products achieve maximum cost savings.

Proven peace of mind

Building on know-how and years of experience, the entire Atlas Copco quality air range is produced in-house and tested using the most stringent methods in the industry.

A dryer solution for every need

Untreated compressed air contains moisture and possibly dirt particles that can damage your air system and contaminate your end product. The resulting maintenance costs far exceed air treatment costs. Atlas Copco believes in effective prevention and provides a complete range of air treatment solutions to protect investments, equipment, production processes and end products.

Rotary drum heat of compression dryers

MDG
-40°C/-20°C
-40°F/-4°F

MD
-20°C/+3°C
-4°F/+37°F

ND
-40°C/-20°C
-40°F/-4°F

- Use of freely available heat of compression
- Negligible power consumption
- Variants with extra heat augmentation for lower dew points

Heat reactivated adsorption dryer

BD/BD+
-70°C/-40°C/-20°C
-94°F/-40°F/-4°F

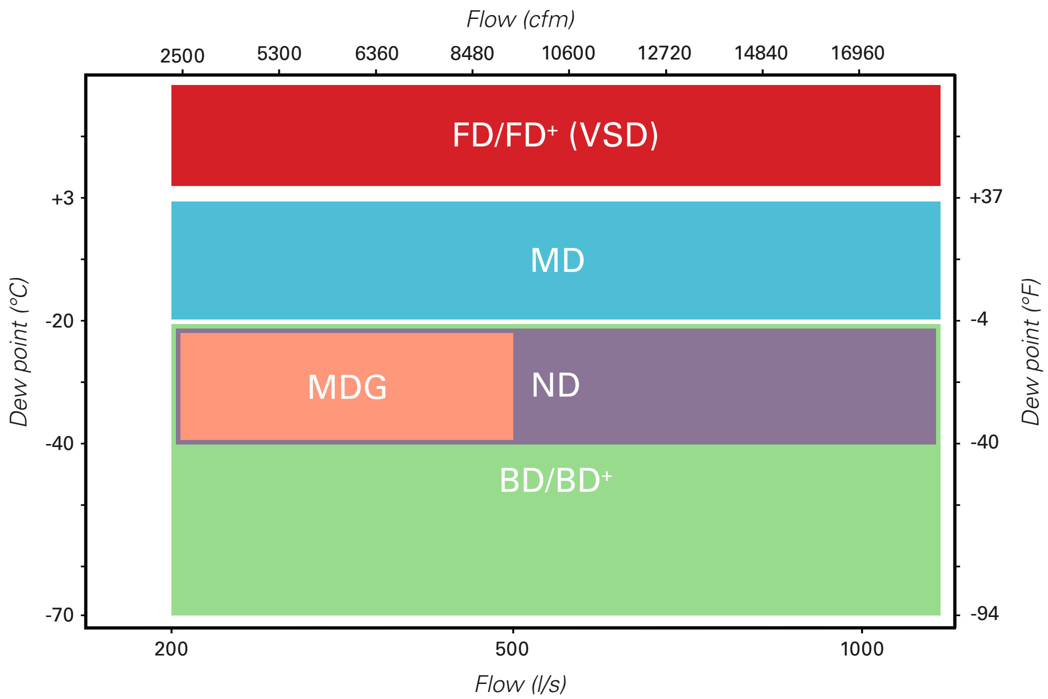
- Use of electrical heaters for regenerating the desiccant
- Limited pressure drop
- Variants without loss of compressed air

Refrigerant dryer

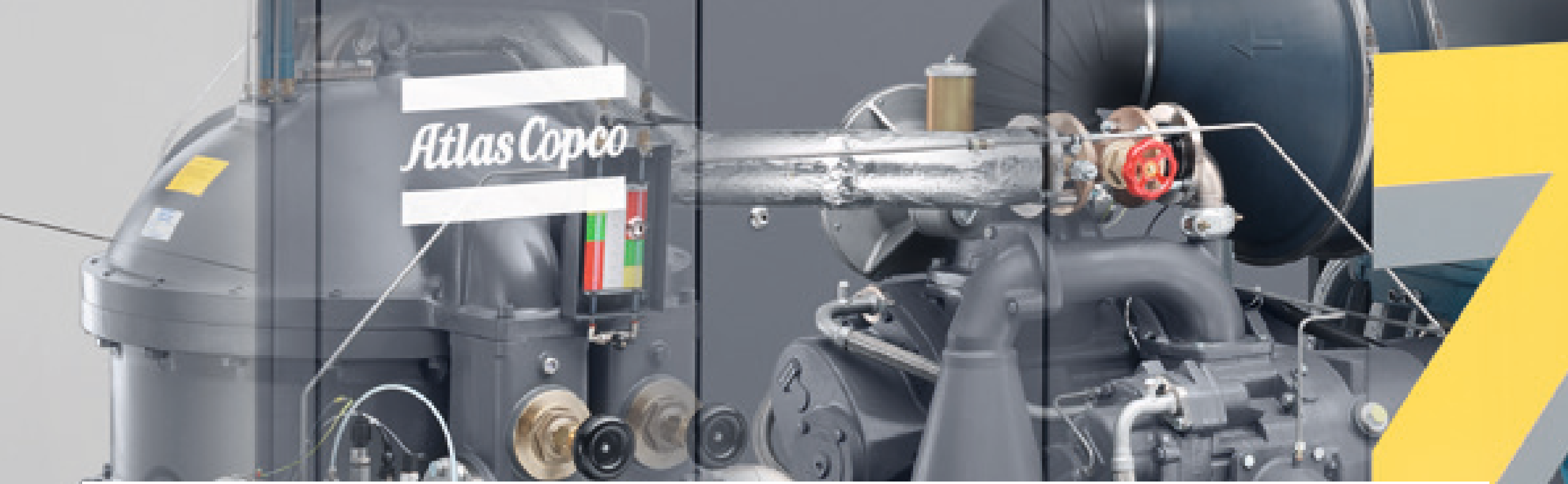
FD/FD+ (VSD)
+3°C/+20°C
+37°F/+68°F

- Use of cooling circuit for cooling down compressed air
- Guaranteed pressure dew points
- Lowest energy consumption in all operating conditions
- Air and water cooled variants

Dryers overview



To further protect your investment, equipment and processes, Atlas Copco presents a full line-up of innovative quality air solutions to suit the high quality requirements of your specific application.



A complete Full Feature package

Atlas Copco's Full Feature concept stands for a compact, all-in-one quality air solution. Integrating the IMD dryer and its Variable Speed Drive on VSD models, this integrated package offers the highest quality air at the lowest possible cost.

Protect your compressed air system

A dry compressed air system is essential to maintain the reliability of production processes and the quality of the end products. Untreated air can cause corrosion in the pipe work, premature failure of pneumatic equipment and product spoilage.

IMD adsorption dryer

The IMD adsorption dryer eliminates the moisture before it enters the air net, ensuring a reliable process and an impeccable end product. As no external energy is needed to dry the air, large savings are obtained. The pressure drop through the dryer is minimal, which again cuts down the operating cost.

The IMD drying principle

1. Hot unsaturated air
2. Hot saturated air
3. Cold saturated air
4. Dry air
5. Drying section

Optimize your system

With the ZR/ZT, Atlas Copco provides an all-in-one standard package incorporating the latest technology in a built-to-last design. To further optimize your ZR/ZT's performance or to simply tailor it to your specific production environment, optional features are available.

Options

	ZR 110 - 275	ZT 110 - 275	ZR 132 - 315 VSD	ZT 132 - 315 VSD
Monitoring & Protection bundle (Anti-Condensation heaters / SPM equipment / PT 1000 in the windings & bearings)	•	•	•	•
SMARTLINK	•	•	•	•
Kit for purge of dry air during standstill (for tropical environment)	•	•	•	•
Dryer by-pass	•	•	•	•
Low load compensator for integrated dryer	•	•	•	•
PDP sensor	•	•	•	•
Silicone-free rotor	•	•	•	•
Anchor pads	•	•	•	•
ANSI flange(s) for air (and water) connections	•	•	•	•
Wooden case protection packaging	•	•	•	•
Duplex oil filter	•	•	•	•
Prefilter kit	•	•	•	•
Separate air intake	•	•	•	•
Teflon-free elements	•	•	•	•
HAT (High ambient temperature) version (*)	•	•	•	•
Hot air variant (= without aftercooler)	•	•	•	•
Material certificates	•	•	•	•
Test certificate	•	•	•	•
Witnessed performance test	•	•	•	•
Energy recovery	•	-	•	-
Water shut-off valve	•	-	•	-
Oversized motor	•	•	-	-
PT 100 in the windings (only for medium voltage motor)	•	•	-	-
Earthing system, IT, TT or TN network	-	-	•	•

(*) Maximum intake/cooling air temperature is 50°C/122 °F for HAT versions.
Please note the availability of the option depends on the chosen configuration.

• : Optional   - : Not available

Engineered solutions

Atlas Copco recognizes the need to combine our serially produced compressors and dryers with the specifications and standards applied by major companies for equipment purchases. Strategically located departments within the Atlas Copco Group take care of the design and manufacturing of customized equipment to operate at extreme temperatures, often in remote locations.

Innovative technology

All equipment is covered by our manufacturer warranty.
The reliability, longevity and performance of our equipment will not be compromised. A global aftermarket operation employing 360 field service engineers in 160 countries ensures reliable maintenance by Atlas Copco as part of a local service operation.

Innovative engineering

Each project is unique and by entering into partnership with our customers, we can appreciate the challenge at hand, ask the relevant questions and design the best engineered solution for all your needs.

Technical specifications
ZR 110-275 (FF)

Type	Free air delivery [1]			Installed motor		Noise level [2]	Weight			
							Standard		Full Feature	
	l/s	m^3/min	cfm	kW	hp	dB(A)	kg	lb	kg	lb
50 Hz										
ZR 110 - 7.5	318.2	19.1	674	110	150	69	2635	5809	2880	6349
ZR 110 - 8.6	286.1	17.2	606	110	150	69	2635	5809	2880	6349
ZR 110 - 10	266.5	16.0	565	110	150	69	2635	5809	2880	6349
ZR 132 - 7.5	365.6	21.9	775	132	150	69	2760	6085	2940	6482
ZR 132 - 8.6	326.4	19.6	692	132	150	69	2760	6085	2940	6482
ZR 132 - 10	314.2	18.9	666	132	150	69	2760	6085	2940	6482
ZR 145 - 7.5	391.6	23.5	830	145	200	70	2900	6393	3080	6790
ZR 145 - 8.6	361.7	21.7	766	145	200	70	2900	6393	3080	6790
ZR 145 - 10	334.5	20.1	709	145	200	69	2900	6393	3080	6790
ZR 145 - 13	304.0	18.2	644	145	200	73	2900	6393	3080	6790
ZR 160 - 7.5	472.2	28.3	1001	160	200	69	3850	8488	5650	12456
ZR 160 - 8.6	435.9	26.2	924	160	200	69	3850	8488	5650	12456
ZR 160 - 10	402.6	24.2	853	160	200	69	3850	8488	5650	12456
ZR 200 - 7.5	602.1	36.1	1276	200	250	67	4000	8818	5800	12787
ZR 200 - 8.6	551.6	33.1	1169	200	250	67	4000	8818	5800	12787
ZR 200 - 10	506.2	30.4	1073	200	250	69	4000	8818	5800	12787
ZR 250 - 7.5	717.6	43.1	1521	250	300	67	4100	9039	5900	13007
ZR 250 - 8.6	683.8	41.0	1449	250	300	67	4100	9039	5900	13007
ZR 250 - 10	622.5	37.4	1319	250	300	67	4100	9039	5900	13007
ZR 250 - 13 [3]	514.9	30.9	1091	250	300	70	4100	9039		
ZR 275 - 7.5	774.1	46.4	1640	275	350	67	4300	9480	6100	13448
ZR 275 - 8.6	717.6	43.1	1521	275	350	67	4300	9480	6100	13448
ZR 275 - 10	683.5	41.0	1448	275	350	67	4300	9480	6100	13448
ZR 275 - 13 [3]	561.8	33.7	1190	275	350	70	4300	9480		
60 Hz										
ZR 110 - 7	347.7	20.9	737	110	150	69	2635	5809	2880	6349
ZR 110 - 8.6	318.2	19.1	674	110	150	69	2635	5809	2880	6349
ZR 110 - 10.4	288.7	17.3	612	110	150	69	2635	5809	2880	6349
ZR 145 - 8.6	395.7	23.7	838	145	200	68	2900	6393	3080	6790
ZR 145 - 10.4	335.9	20.2	712	145	200	69	2900	6393	3080	6790
ZR 145 - 13	315.2	18.9	668	145	200	73	2900	6393	3080	6790
ZR 160 - 7	465.4	27.9	986	160	200	69	3850	8488	5650	12456
ZR 160 - 8.6	423.5	25.4	897	160	200	69	3850	8488	5650	12456
ZR 160 - 10.4	375.5	22.5	796	160	200	69	3850	8488	5650	12456
ZR 200 - 7	575.1	34.5	1219	200	250	67	4000	8818	5800	12787
ZR 200 - 8.6	519.1	31.1	1100	200	250	69	4000	8818	5800	12787
ZR 200 - 10.4	459.6	27.6	974	200	250	69	4000	8818	5800	12787
ZR 250 - 7	667.0	40.0	1413	250	300	67	4100	9039	5900	13007
ZR 250 - 8.6	621.7	37.3	1317	250	300	67	4100	9039	5900	13007
ZR 250 - 10.4	546.9	32.8	1159	250	300	69	4100	9039	5900	13007
ZR 250 - 13 [3]	500.6	30.0	1061	250	300	70	4100	9039		
ZR 275 - 7	749.9	45.0	1589	275	350	67	4300	9480	6100	13448
ZR 275 - 8.6	725.3	43.5	1537	275	350	67	4300	9480	6100	13448
ZR 275 - 10.4	640.0	38.4	1356	275	350	67	4300	9480	6100	13448
ZR 275 - 13 [3]	561.5	33.7	1190	275	350	70	4300	9480		

(1) Unit performance measured according to ISO 1217, Annex C & E, Edition 4 (2009).
Reference conditions:
- Relative humidity 0%.
- Absolute inlet pressure: 1 bar (14.5 psi).
- Intake air temperature: 20°C/68°F.
FAD is measured at the following working pressures:
Fixed speed:
- 7/7.5/8.6 bar versions at 7 bar.
- 10/10.4 bar versions at 9 bar.
- 13 bar version at 12 bar.
For VSD: at their maximum working pressure.

(2) A-weighted emission sound pressure level at the work station (LpWSAd).

Measured according to ISO 2151: 2004 using ISO 9614/2 (sound intensity scanning method).
The added correction factor (+/- 3 dB(A)) is the total uncertainty value (KpAd) conform with the test code.

(3) Not available as FF variant.

Technical specifications
ZT 110-275 (FF)

Type	Free air delivery (1)			Installed motor		Noise level (2)	Weight			
							Standard		Full Feature	
	l/s	m^3/min	cfm	kW	hp	dB(A)	kg	lb	kg	lb
50 Hz										
ZT 110 - 7.5	306.9	18.4	650	110	150	71	3560	7848	4070	8973
ZT 110 - 8.6	286.2	17.2	606	110	150	71	3560	7848	4070	8973
ZT 110 - 10	266.9	16.0	566	110	150	71	3560	7848	4070	8973
ZT 132 - 7.5	363.1	21.8	769	132	150	72	3700	8157	4210	9281
ZT 132 - 8.6	325.2	19.5	689	132	150	72	3700	8157	4210	9281
ZT 132 - 10	313.3	18.8	664	132	150	72	3700	8157	4210	9281
ZT 145 - 7.5	387.3	23.2	821	145	200	72	3850	8488	4360	9612
ZT 145 - 8.6	358.4	21.5	759	145	200	72	3850	8488	4360	9612
ZT 145 - 10	332.3	19.9	704	145	200	72	3850	8488	4360	9612
ZT 160 - 7.5	465.5	27.9	986	160	200	77	5150	11354	6350	13999
ZT 160 - 8.6	429.4	25.8	910	160	200	77	5150	11354	6350	13999
ZT 160 - 10	396.3	23.8	840	160	200	78	5150	11354	6350	13999
ZT 200 - 7.5	568.4	34.1	1204	200	250	78	5250	11574	6450	14220
ZT 200 - 8.6	521.7	31.3	1105	200	250	78	5250	11574	6450	14220
ZT 200 - 10	499.6	30.0	1059	200	250	78	5250	11574	6450	14220
ZT 250 - 7.5	706.3	42.4	1497	250	300	77	5300	11684	6500	14330
ZT 250 - 8.6	673.5	40.4	1427	250	300	78	5300	11684	6500	14330
ZT 250 - 10	613.9	36.8	1301	250	300	78	5300	11684	6500	14330
ZT 275 - 7.5	738.1	44.3	1564	275	350	77	5400	11905	6600	14550
ZT 275 - 8.6	706.3	42.4	1497	275	350	78	5400	11905	6600	14550
ZT 275 - 10	673.1	40.4	1426	275	350	78	5400	11905	6600	14550
60 Hz										
ZT 110 - 8.6	317.7	19.1	673	110	150	71	3560	7848	4070	8973
ZT 110 - 10.4	288.6	17.3	612	110	150	71	3560	7848	4070	8973
ZT 145 - 8.6	391.2	23.5	829	145	200	72	3850	8488	4360	9612
ZT 145 - 10.4	334.1	20.0	708	145	200	72	3850	8488	4360	9612
ZT 160 - 8.6	416.9	25.0	883	160	200	77	5150	11354	6350	13999
ZT 160 - 10.4	371.0	22.3	786	160	200	78	5150	11354	6350	13999
ZT 200 - 8.6	512.1	30.7	1085	200	250	77	5150	11354	6350	13999
ZT 200 - 10.4	453.2	27.2	960	200	250	78	5150	11354	6350	13999
ZT 250 - 8.6	613.0	36.8	1299	250	300	78	5300	11684	6500	14330
ZT 250 - 10.4	540.1	32.4	1144	250	300	78	5300	11684	6500	14330
ZT 275 - 8.6	713.7	42.8	1512	275	350	78	5400	11905	6600	14550
ZT 275 - 10.4	630.9	37.9	1337	275	350	78	5400	11905	6600	14550

(1) Unit performance measured according to ISO 1217, Annex C & E, Edition 4 (2009).
Reference conditions:
- Relative humidity 0%.
- Absolute inlet pressure: 1 bar (14.5 psi).
- Intake air temperature: 20°C/68°F.
FAD is measured at the following working pressures:
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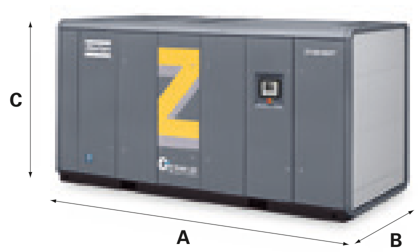
- 13 bar version at 12 bar.
For VSD: at their maximum working pressure.

(2) A-weighted emission sound pressure level at the work station (LpWSAd).

Measured according to ISO 2151: 2004 using ISO 9614/2 (sound intensity scanning method).
The added correction factor (+/- 3 dB(A)) is the total uncertainty value (KpAd) conform with the test code.

Dimensions

Type	Standard						Full Feature					
	A (Length)		B (Width)		C (Height)		A (Length)		B (Width)		C (Height)	
	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
ZR 110-145	2540	100.0	1650	65.0	2000	78.7	3440	135.4	1650	65.0	2000	78.7
ZR 160-275	3140	123.0	1650	65.0	2000	78.7	4340	170.9	1650	65.0	2000	78.7
ZT 110-145	4040	159.1	1650	65.0	2000	78.7	4040	159.1	1650	65.0	2000	78.7
ZT 160-275	5040	198.4	1650	65.0	2100	82.7	5040	198.4	1650	65.0	2100	82.7



Technical specifications
ZR 132-315 VSD (FF) (50/60 Hz)

Type	Working pressure (1)		Free air delivery (2)			Noise level (3)	Weight			
							Standard		Full Feature	
		bar(e)	l/s	m³/min	cfm	dB(A)	kg	lb	kg	lb
ZR 132 VSD - 8.6 bar(e)	Minimum	3.5	130 - 440	7.8 - 26.4	276 - 932	74	2870	6327	3500	7716
	Effective	7	129 - 374	7.7 - 22.4	273 - 792					
	Maximum	8.6	128 - 343	7.7 - 20.6	272 - 727					
ZR 132 VSD - 10.4 bar(e)	Minimum	6	119 - 373	7.1 - 22.4	252 - 789	74	2870	6327	3500	7716
	Effective	9	122 - 337	7.3 - 20.2	258 - 715					
	Maximum	10.4	137 - 313	8.2 - 18.8	291 - 663					
ZR 160 VSD - 8.6 bar(e)	Minimum	3.5	130 - 440	7.8 - 26.4	276 - 931	74	2870	6327	3500	7716
	Effective	7	129 - 431	7.7 - 25.9	273 - 914					
	Maximum	8.6	128 - 398	7.7 - 23.9	272 - 843					
ZR 160 VSD - 10.4 bar(e)	Minimum	6	119 - 412	7.1 - 24.7	252 - 872	74	2870	6327	3500	7716
	Effective	9	122 - 392	7.3 - 23.5	258 - 831					
	Maximum	10.4	137 - 366	8.2 - 21.9	291 - 774					
ZR 250 VSD - 8.6 bar(e)	Minimum	3.5	244 - 831	14.7 - 49.8	518 - 1760	73	4600	10141	6400	14109
	Effective	7	243 - 714	14.6 - 42.9	514 - 1514					
	Maximum	8.6	242 - 660	14.5 - 39.6	513 - 1399					
ZR 250 VSD - 10.4 bar(e)	Minimum	6	211 - 742	12.7 - 44.5	447 - 1572	73	4600	10141	6400	14109
	Effective	9	234 - 640	14.0 - 38.4	496 - 1357					
	Maximum	10.4	322 - 592	19.3 - 35.5	682 - 1254					
ZR 315 VSD - 8.6 bar(e)	Minimum	3.5	244 - 831	14.7 - 49.8	518 - 1760	73	4600	10141	6400	14109
	Effective	7	243 - 830	14.6 - 49.8	514 - 1759					
	Maximum	8.6	242 - 775	14.5 - 46.5	513 - 1642					
ZR 315 VSD - 10.4 bar(e)	Minimum	6	211 - 749	12.7 - 44.9	447 - 1587	73	4600	10141	6400	14109
	Effective	9	234 - 737	14.0 - 44.2	496 - 1563					
	Maximum	10.4	322 - 698	19.3 - 41.9	682 - 1478					

(1) For the working pressure of the FF variant, please consult Atlas Copco.

(2) Unit performance measured according to ISO 1217, Annex C & E, Edition 4 (2009).
Reference conditions:
- Relative humidity 0%.
- Absolute inlet pressure: 1 bar (14.5 psi).
- Intake air temperature: 20°C/68°F.
FAD is measured at the following working pressures:
Fixed speed:
- 7/7.5/8.6 bar versions at 7 bar.
- 10/10.4 bar versions at 9 bar.
- 13 bar version at 12 bar.
For VSD: at their maximum working pressure.

(3) A-weighted emission sound pressure level at the work station (LpWSAd).

Measured according to ISO 2151: 2004 using ISO 9614/2 (sound intensity scanning method).
The added correction factor (+/- 3 dB(A)) is the total uncertainty value (KpAd) conform with the test code.

Technical specifications
ZT 132-315 VSD (FF) (50/60 Hz)

Type	Working pressure (1)		Free air delivery (2)			Noise level (3)	Weight			
							Standard		Full Feature	
		bar(e)	l/s	m^3/min	cfm	dB(A)	kg	lb	kg	lb
	Minimum	3.5	128 - 419	7.7 - 25.1	272 - 888					
ZT 132 VSD - 8.6 bar(e)	Effective	7	127 - 363	7.6 - 21.8	269 - 768	76	3820	8422	4330	9546
	Maximum	8.6	127 - 335	7.6 - 20.1	268 - 711					
	Minimum	6	148 - 362	8.9 - 21.7	315 - 768					
ZT 132 VSD - 10.4 bar(e)	Effective	9	178 - 330	10.7 - 19.8	377 - 699	76	3820	8422	4330	9546
	Maximum	10.4	199 - 307	11.9 - 18.4	421 - 651					
	Minimum	3.5	128 - 419	7.7 - 25.1	272 - 888					
ZT 160 VSD - 8.6 bar(e)	Effective	7	127 - 409	7.6 - 24.6	269 - 868	76	3820	8422	4330	9546
	Maximum	8.6	127 - 380	7.6 - 22.8	268 - 806					
	Minimum	6	148 - 392	8.9 - 23.5	315 - 831					
ZT 160 VSD - 10.4 bar(e)	Effective	9	178 - 375	10.7 - 22.5	377 - 795	76	3820	8422	4330	9546
	Maximum	10.4	199 - 352	11.9 - 21.1	421 - 746					
	Minimum	3.5	240 - 824	14.4 - 49.4	508 - 1746					
ZT 250 VSD - 8.6 bar(e)	Effective	7	238 - 697	14.3 - 41.8	504 - 1477	78	5750	12676	6950	15322
	Maximum	8.6	237 - 645	14.2 - 38.7	502 - 1367					
	Minimum	6	216 - 727	13.0 - 43.6	458 - 1540					
ZT 250 VSD - 10.4 bar(e)	Effective	9	214 - 638	12.9 - 38.3	454 - 1352	78	5750	12676	6950	15322
	Maximum	10.4	416 - 596	25.0 - 35.7	881 - 1262					
	Minimum	3.5	240 - 833	14.4 - 50.0	508 - 1765					
ZT 315 VSD - 8.6 bar(e)	Effective	7	238 - 788	14.3 - 47.3	504 - 1670	78	5750	12676	6950	15322
	Maximum	8.6	237 - 735	14.2 - 44.1	502 - 1557					
	Minimum	6	216 - 763	13.0 - 45.8	458 - 1616					
ZT 315 VSD - 10.4 bar(e)	Effective	9	214 - 725	12.9 - 43.5	454 - 1535	78	5750	12676	6950	15322
	Maximum	10.4	416 - 681	25.0 - 40.9	881 - 1444					

(1) For the working pressure of the FF variant, please consult Atlas Copco.

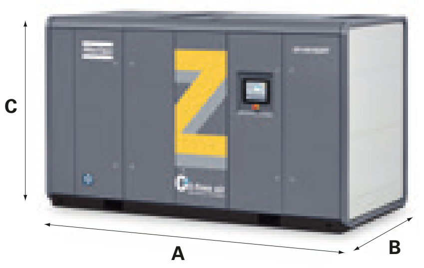
(2) Unit performance measured according to ISO 1217, Annex C & E, Edition 4 (2009).
Reference conditions:
- Relative humidity 0%.
- Absolute inlet pressure: 1 bar (14.5 psi).
- Intake air temperature: 20°C/68°F.
FAD is measured at the following working pressures:
Fixed speed:
- 7/7.5/8.6 bar versions at 7 bar.
- 10/10.4 bar versions at 9 bar.
- 13 bar version at 12 bar.
For VSD: at their maximum working pressure.

(3) A-weighted emission sound pressure level at the work station (LpWSAd).

Measured according to ISO 2151: 2004 using ISO 9614/2 (sound intensity scanning method).
The added correction factor (+/- 3 dB(A)) is the total uncertainty value (KpAd) conform with the test code.

Dimensions

Type	Standard						Full Feature					
	A (Length)		B (Width)		C (Height)		A (Length)		B (Width)		C (Height)	
	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
ZR 132-160 VSD	2540	100.0	1650	65.0	2000	78.7	3440	135.4	1650	65.0	2000	78.7
ZR 250-315 VSD	3140	123.6	1650	65.0	2000	78.7	4340	170.9	1650	65.0	2000	78.7
ZT 132-160 VSD	4040	159.1	1650	65.0	2000	78.7	4040	159.1	1650	65.0	2000	78.7
ZT 250-315 VSD	5040	198.4	1650	65.0	2100	82.7	5040	198.4	1650	65.0	2100	82.7



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Appendix B CompAir – quotes and technical information

From:	Childs, Owen
To:	Fred Chaaya
Subject:	RE: Comp Air - Oil Free Compressors
Date:	Friday, 9 September 2022 2:51:45 PM
Attachments:	image013.png image005.png image006.png image007.png image008.png image009.png

Hi Fred,

Please see below table regarding the compressors and their costs. As discussed yesterday we do have de-stratification compressors in operation at Woronora and Nepean Dams, so it may be possible to use an oil lubricated screw and fill it with a food grade oil instead.

I've given you the option of the Fixed/Variable speeds in the 110kW range to match your air requirements, but have also quoted the 200kW units for your consideration.

The installation costs are an estimate only based on the location and what type of pipework may be required to connect it all up, but this could easily become $50-100K dependent on the real scope of work.

When it comes to decommissioning the compressors, a local mechanical fitter or plumber could potentially disconnect the pipework from the compressors, and you then be left with the transport costs (which could involve forklift or crane hire). This would be a one to two day job that would cost around $5,000 in labour/travel if we were to do it from Sydney.

Ideally the compressors are situated in a shed that can be closed to the weather conditions as the IP ratings generally aren't high enough for outdoor use. A slab of concrete will be fine if laid properly with a shed over the top. If you get to this point, sing out as we can work on the design to assist.

NB: It may be interesting to see if a skid package is worthwhile. Everything setup on a skid frame that can be dropped off on site ready to pipe into the inlet. We could also potentially set this type of package up with a generator (no promises), but there are ways to do this that may be worth looking in to.

D110, Fixed Speed, Oil Free, Screw Compressor, Two Stage, 110kW, 10 Bar, 17.39m3/min FAD, Direct Drive, Air Cooled	1	$140,690
D110RS, Variable Speed, Oil Free, Screw Compressor, Two Stage, 110kW, 10 Bar, 17.37m3/min FAD, Direct Drive, Air Cooled	1	$157,728
D200, Fixed Speed, Oil Free, Screw Compressor, Two Stage, 200kW, 10 Bar, 32m3/min FAD, Direct Drive, Air Cooled	1	$238,711
L200e-10A V2 Two Stage Fixed		

Speed, Air Cooled Lubricated Screw Compressor, Frame 6 / Direct Drive / 10 Bar / 200 kW / 35.64 m3/min / DN80 PN16 Flange	1	$103,854
4000HR Food Grade Oil, H-1 Approved	1	$4,979
Transport to Pindari Dam per Compressor	1	$6,000
Installation Estimation Only - Does not include, civil works, enclosures, lifting equipnent, forklifts or scissor lifts if required	1	$30,000

Kind Regards,

Owen Childs
Sales – Compressors (NSW & ACT)

Industrial Technologies and Services

Gardner Denver
13 Arnott Place
Wetherill Park, NSW 2164
Australia

Mobile +61 (0)419 891 774
Email owen.childs@irco.com

https://www.gardnerdenver.com/en-au
https://www.ingersollrand.com/en-au
https://www.compair.com/en-au

From: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Sent: Thursday, September 8, 2022 3:39 PM
To: Childs, Owen <Owen.Childs@irco.com>
Subject: RE: Comp Air - Oil Free Compressors

Hey Owen,

I was hoping I could tack on one additional request to the quote I contacted you on Monday about.

Given this system is designed to be a trial, it would be good for us to understand how much it might cost to decommission and remove the system at the end of the trial period.

Are you aware of any experience that CompAir or Ingersoll Rand has with destratification systems in reservoirs? We will need to consider how we install the distribution pipeline and diffuser for the system – I'm wondering whether this is something that could be provided as part of the compressor supply. Just postulating, something to consider later.

Thanks,
Fred

Fred Chaaya
Project Engineer

Water Research Laboratory
School of Civil and Environmental Engineering, UNSW Sydney
110 King St, Manly Vale NSW 2093 Australia

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From: Fred Chaaya
Sent: Monday, 5 September 2022 1:09 PM
To: Childs, Owen <Owen.Childs@irco.com>
Subject: RE: Comp Air - Oil Free Compressors

Hey Owen,

As per our recent conversation over the phone, I was hoping you could prepare a more detailed quote/budget so we can start looking at refining the budget for our project.

I mentioned that we were trying to artificially destratify (i.e. mix) reservoirs for the purposes of warming up the waters released. We're hoping to trial one of these systems at Pindari Dam, up in northern NSW. This is a pretty remote location so I'd appreciate any costing you could do for delivery and installation of the system. Could you also include pricing of a service agreement?

If you have any information about additional requirements we might need (security fencing, housing for the compressor, slab requirements etc.) that would be well received. I understand this might not be part of your services, however your experience with installing compressors will go a long way!

To reiterate the specs we required:

- 500 L/s air flow rate
- Capable of operating up to 10 bar
- Options for fixed air flow rate and a variable speed drive (considering a system one of each)
- Oil-free

We'll be pumping air to a maximum of 73 m below the water level. I've assumed 10 bar will be enough to account for the water head pressure and any pneumatic losses along the pipelines. If you have any recommendations on pressure ratings, please let me know.

Let me know if there's any other information you might require. If you could prepare this before the end of this week, that would be most helpful!

Thank you,
Fred

Fred Chaaya
Project Engineer

Water Research Laboratory
School of Civil and Environmental Engineering, UNSW Sydney
110 King St, Manly Vale NSW 2093 Australia

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W: wrl.unsw.edu.au

From: Childs, Owen <Owen.Childs@irco.com>
Sent: Friday, 12 August 2022 11:04 AM
To: Fred Chaaya <f.chaaya@wrl.unsw.edu.au>
Subject: Comp Air - Oil Free Compressors

Hi Fred,

Thanks for your time earlier on the phone today.

I have attached a brochure on our oil free compressors to suit your initial thoughts.

As it is water contact air, you will need an Oil Free compressor with appropriate filters to maintain air quality on contact, which we can specify at a later point.

At 500L/s, you will need a Free Air Delivery (FAD) of approximately 30m3/min. This puts you in the range of the D200RS (Regulated Speed/Variable Speed Drive). If your system required more than this, then ideally you would be running a 2 unit setup to achieve your requirements. There are multiple ways to do this, but it may not hurt to have a redundancy against this system as the 200kW unit would still be running flat out to keep up with your demands if it was being run 24/7. If the air use was constant, a Fixed Speed unit may be more appropriate. Similar to your car/vehicle, VSDs don't operate well if constantly run in top or bottom gear for extended periods of time. You might find that a 2 unit system, with one fixed speed, and one variable speed may be more efficient.

A receiver unit close to point of use would balance out the system slightly, allowing the compressor to top the tank up to pressure as it delivered air into the system. A large tank of around 4000L for a compressor this size would allow you to maintain a higher pressure in the tank as air is delivered in order to minimize pressure loss.

Something to consider also is whether or not dry air quality is of importance to you. Generally, air maintained at a 3 degree C dew point is enough for most systems, which can be done with a refrigerated dryer. This refers to the temperature that the air starts condensing any moisture it has retained back into the system. If the air needs to be super dry, then a desiccant dryer is required, and that will need a whole different set of calculations based on what you are trying to achieve.

Let me know if there's any further information I can provide for you to assist in your understanding.

I look forward to discussing this project further.

Kind Regards,

Owen Childs
Sales – Compressors (NSW & ACT)

Industrial Technologies and Services

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Wetherill Park, NSW 2164
Australia

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https://www.gardnerdenver.com/en-au
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CompAir	D110-10RS	TIS D110RS-10/10/CE
	Technical Information Sheet	V2
	Variable Speed, Air Cooled, CE Version	29.01.2013

Performance Data

		D110-10RS
Maximum working pressure	bar g	10.0
Minimum working pressure	bar g	4.0
Ambient temperature	℃	2 / 40

				min.	1	2	3	4	max.
4bar	FAD*	(Male rotor speed - rpm)	m^3/min	**10.88** (8000)	**12.25** (8765)	**13.62** (9552)	**14.98** (10365)	**16.35** (11205)	**17.71** (12075)
	Total input power*	(P spec. - kW min/m³)	kW	67.34 (6.19)	74.37 (6.07)	81.64 (6.00)	89.15 (5.95)	96.90 (5.93)	104.90 (5.92)
5 bar	FAD*		m^3/min	**10.82** (8000)	**12.19** (8769)	**13.56** (9559)	**14.92** (10372)	**16.29** (11210)	**17.66** (12075)
	Total input power*		kW	72.09 (6.66)	78.97 (6.48)	86.20 (6.36)	93.80 (6.29)	101.77 (6.25)	110.09 (6.23)
6 bar	FAD*		m^3/min	**10.75** (8000)	**12.12** (8773)	**13.50** (9565)	**14.87** (10379)	**16.24** (11215)	**17.61** (12075)
	Total input power*		kW	77.26 (7.18)	83.91 (6.92)	91.07 (6.75)	98.74 (6.64)	106.91 (6.58)	115.59 (6.56)
7 bar	FAD*		m^3/min	**10.69** (8000)	**12.06** (8777)	**13.44** (9572)	**14.81** (10385)	**16.18** (11219)	**17.55** (12075)
	Total input power*		kW	82.13 (7.68)	88.88 (7.37)	96.18 (7.16)	104.04 (7.03)	112.45 (6.95)	121.41 (6.92)
7,5 bar	FAD*		m^3/min	**10.66** (8000)	**12.03** (8779)	**13.41** (9575)	**14.78** (10389)	**16.15** (11222)	**17.53** (12075)
	Total input power*		kW	84.54 (7.93)	91.44 (7.60)	98.88 (7.38)	106.87 (7.23)	115.41 (7.14)	124.49 (7.10)
8 bar	FAD*		m^3/min	**10.63** (8000)	**12.00** (8781)	**13.38** (9578)	**14.75** (10392)	**16.13** (11224)	**17.50** (12075)
	Total input power*		kW	86.96 (8.18)	94.00 (7.83)	101.59 (7.59)	109.71 (7.44)	118.37 (7.34)	127.57 (7.29)
9 bar	FAD*		m^3/min	**10.56** (8000)	**11.94** (8785)	**13.32** (9584)	**14.70** (10398)	**16.07** (11229)	**17.45** (12075)
	Total input power*		kW	91.70 (8.68)	99.27 (8.31)	107.30 (8.06)	115.77 (7.88)	124.70 (7.76)	134.08 (7.68)
10 bar	FAD*		m^3/min	**10.50** (8000)	**11.88** (8789)	**13.26** (9591)	**14.64** (10405)	**16.02** (11233)	**17.40** (12075)
	Total input power*		kW	96.75 (9.21)	104.89 (8.83)	113.38 (8.55)	122.22 (8.35)	131.43 (8.20)	140.98 (8.10)

Total input power at no load, fan switched off	kW	22.3
Male rotor speed 1st stage	rpm	8000 to 12075
Male rotor speed 2nd stage	rpm	11200 to 16905
Approx. discharge temperature of air above ambient (at max. power)	℃	7.0
Free field noise level ** at 70% load / at 100% load	dB(A)	76 / 78

Electrical Data

Nominal motor rating	kW	110
Nominal voltage [tolerance] (Frequency)		380V[+10% -5%]; 400V[±10%]; (50Hz)
Full load current max. at 380V / 400V / 460V	A	262 / 249
Starting current (max. % of full load current)	%	100
Standard drive motor detail		IP55 (IE-3) - IEC 60034-2-1 ECA Qualifying
Drive motor speed min./max.	rpm	2400 / 3623
Fan motor rating	kW	2 x 3,2 (IP-54)
Oil pump motor rating	kW	0,55 (IP-54)
Water pump motor rating	KW	0,75 (IP-54)
Suggested cable size at 380V / 400V / 460V (max.30℃ / max. 50m / Copper)	mm2	2 x 3 x 50 PE50 / 2 x 3 x 50 PE50
Suggested fuse rating at 380V / 400V / 460V (type gG)	A	6 x 160 / 6 x 160

Cooling Data

Ventilating fan capacity	m3/min	338
Heat rejected by ventilating fan (max. % of actual input power)	%	95
Size of cooling air inlet aperture	mm	1210 x 975
Size of cooling air outlet aperture	mm	1578 x 1390
Approx. cooling air temperature above ambient (at max. power)	℃	22
Max. allowable pressure drop in duct at ambient 35°C / 45℃	Pa	120 / 85

Weights, Dimensions and Capacities Data

Compressor water capacity (water / gycol mixture)	l	30
Compressor oil capacity	l	24
Compressed air delivery connection		Flange EN 1092-1 / 13 / B1 / DN80x8 / PN16
Condensate drains		5 x G1/2"
Weight	kg	3278
Package dimensions L x W x H	mm	2597 x 1744 x 2001

* Data measured and stated in accordance with ISO1217 4rd Edition Annex C & E and at the following conditions:
Air Intake Pressure: 1 bar a / 14.5 psia
Air Intake Temperature: 20℃ / 68℉
Humidity: 0% (dry)

** Measured in free field conditions in accordance with the ISO 2151, tolerance ± 3dB(A).

*** max. 30℃ / max. 50m / Copper

Gardner Denver policy is one of continuous improvement and we therefore reserve the right to alter specifications without prior notice.

CompAir	D110	TIS D110/10/CE
	Technical Information Sheet	V2
	50 Hz, Fix Speed, Air Cooled, CE Version	30.09.2014

Performance Data			**D110**			
Maximum working pressure		bar g	8.0		10.0	
Minimum working pressure		bar g	4.0			
Ambient temperature min/max		℃	2 / 45		2 / 40	
4 bar	FAD* FAD*	m³/min	**19.82**		**17.67**	
	Total input power* (P spec. - kW min/m³)	kW	104.03	(5.25)	94.21	(5.33)
5 bar	FAD*	m³/min	**19.74**		**17.63**	
	Total input power*	kW	112.84	(5.72)	101.88	(5.78)
6 bar	FAD*	m³/min	**19.67**		**17.58**	
	Total input power*	kW	120.83	(6.14)	108.68	(6.18)
7 bar	FAD*	m³/min	**19.59**		**17.53**	
	Total input power*	kW	128.29	(6.55)	114.98	(6.56)
7,5 bar	FAD*	m³/min	**19.55**		**17.51**	
	Total input power*	kW	131.88	(6.75)	118.03	(6.74)
8 bar	FAD*	m³/min	**19.51**		**17.48**	
	Total input power*	kW	135.43	(6.94)	121.06	(6.93)
9 bar	FAD*	m³/min			**17.43**	
	Total input power*	kW			127.14	(7.29)
10 bar	FAD*	m³/min			**17.39**	
	Total input power*	kW			133.41	(7.67)
Total input power at no load, 1 fan switched off		kW	31.0		30.0	
Male rotor speed 1st stage		rpm	13410		12128	
Male rotor speed 2nd stage		rpm	20115		16792	
Approx. discharge temperature of air above ambient		℃	6		6	
Free field noise level **		dB(A)	77		77	
Electrical Data						
Nominal motor rating		kW	110			
Nominal voltage [Tolerance] (Frequency)			400V[±10%]; (50Hz)			
Full load current max. at 400V		A	249			
Starting current (max. % of full load current)		%	250			
Standard drive motor detail			IP55 (IE-3) - IEC 60034-2-1 ECA Qualifying			
Drive motor speed		rpm	2970			
Fan motor rating		kW	2 x 3,2 (IP-54)			
Oil pump motor rating		kW	0,55 (IP-54)			
Water pump motor rating		kW	0,75 (IP-54)			
Suggested cable size at 400V ***		mm²	2 x 3 x 50 PE50			
Suggested fuse rating at 400V (type gG)		A	6 x 160			
Cooling Data						
Ventilating fan capacity		m³/min	338			
Heat rejected by ventilating fan (max % of actual input power)		%	95			
Size of cooling air inlet aperture		mm	1210 x 975			
Size of cooling air outlet aperture		mm	1578 x 1390			
Approx. cooling air temp. above ambient (at max. power)		℃	22			
Max. allowable pressure drop in duct at ambient		Pa	120 / 40 [35℃ / 45℃]		120 / 85 [35℃ / 40℃]	
Weights, Dimensions and Capacities Data						
Compressor water capacity (Water / Glycol mixture)		l	30			
Compressor oil capacity		l	24			
Compressed air delivery connection			Flange EN 1092-1 / 13 / B1 / DN80x8 / PN16			
Condensate Drains			5 x G1/2"			
Weight		kg	3265			
Package dimensions L x W x H		mm	2597 x 1744 x 2001			

* Data measured and stated in accordance with ISO1217 4rd Edition Annex C and at the following conditions:
Air Intake Pressure: 1 bar a / 14.5 psia
Air Intake Temperature: 20℃ / 68℉
Humidity: 0% (dry)

** Measured in free field conditions in accordance with the ISO 2151, tolerance ± 3dB(A).

*** max. 30℃ / max. 50m / Copper

Gardner Denver policy is one of continuous improvement and we therefore reserve the right to alter specifications without prior notice.

CompAir	D200	TIS D200/11/CE
	Technical Information Sheet	[WEG] V2
	50Hz, Fix Speed, Air Cooled, CE Version	[Eng.Vers.3] 10/2018

Performance Data		**D200**			
Maximum working pressure	bar g	8,0		10,0	
Minimum working pressure	bar g	4,0			
Ambient temperature min / max	°C	2 / 45		2 / 40	
4 bar FAD*	m3/min	**35,8**		**32,2**	
4 bar Total input power* (P spec. - kW min/m³)	kW	194,5	(5,43)	171,3	(5,32)
5 bar FAD*	m3/min	**36,2**		**32,6**	
5 bar Total input power*	kW	206,9	(5,72)	184,4	(5,66)
6 bar FAD*	m3/min	**36,4**		**32,7**	
6 bar Total input power*	kW	219,9	(6,04)	197,4	(6,04)
7 bar FAD*	m3/min	**36,3**		**32,6**	
7 bar Total input power*	kW	230,8	(6,36)	209,5	(6,43)
7,5 bar FAD*	m3/min	**36,2**		**32,6**	
7,5 bar Total input power*	kW	237,5	(6,56)	215,6	(6,61)
8 bar FAD*	m3/min	**36,1**		**32,5**	
8 bar Total input power*	kW	244,7	(6,78)	222,2	(6,84)
9 bar FAD*	m3/min			**32,2**	
9 bar Total input power*	kW			236,5	(7,34)
10 bar FAD*	m3/min			**32**	
10 bar Total input power*	kW			250,8	(7,84)
Total input power at no load	kW	57,5		51,6	
Male rotor speed 1 st stage	rpm	8222		7500	
Male rotor speed 2 nd stage	rpm	11100		9457	
Approx. discharge temperature of air above ambient	°C	10		12	
Free field noise level **	dB(A)	81		81	
Electrical Data					
Nominal motor rating	kW	200			
Nominal voltage [tolerance] (Frequency)		400V[±10%]; (50Hz)			
Full load current max. at 400V	A	456			
Starting current (max. % of full load current)	%	281			
Standard drive motor detail		IP55 (IE-3) - IEC 60034-2-1 ECA Qualifying			
Drive motor speed	rpm	2990			
Fan motor rating	kW	4 x 3,8 (IP-54)			
Oil pump motor rating	kW	0,75 (IP-55 / IE3)			
Water pump motor rating	KW	1,80 (IP-55 / IE3)			
Suggested cable size at 400V (max.30°C / max. 50m / Copper)***	mm2	2 x 3 x 150 PE150			
Suggested fuse rating at 400V (time delayed)	AgG	2 x 3 x 315			
Cooling Data					
Ventilating fan capacity	m3/min	715		655	
Heat rejected by ventilating fan (max % of actual input power)	%	95			
Size of cooling air inlet aperture	mm	1465 x 1030			
Size of cooling air outlet aperture	mm	2302 x 1794			
Approx. cooling air temp. above ambient (at max. power)	°C	18		20	
Max. allowable pressure drop in duct at ambient 35°C / 40°C / 45°C	Pa	auf Anfrage / on demand			
Weights, Dimensions and Capacities Data					
Compressor water capacity (Water/ Glycol mixture)	l	37			
Compressor oil capacity	l	45			
Compressed air delivery connection		Flange EN 1092-1 / 13 / B1 / DN80x8 / PN16			
Condensate Drains		6 x G1/2"			
Weight	kg	5515			
Package dimensions L x W x H	mm	3300 x 1994 x 2190			

* Data measured and stated in accordance with ISO1217 4th Edition Annex C and at the following conditions:
Air Intake Pressure: 1 bar a / 14.5 psia
Air Intake Temperature: 20°C / 68°F
Humidity: 0% (dry)

** Measured in free field conditions in accordance with the ISO 2151, tolerance ± 3dB(A).

*** max. 30°C / max. 50m / Copper

CompAir policy is one of continuous improvement and we therefore reserve the right to alter specifications without prior notice.

CompAir	L160e - L200e 60Hz				TIS L160e-L200e/12/CE
	Technical Information Sheet				Rev.A
	Fixed Speed, **Air** Cooled, **CE** Version				01.09.2021

Performance Data			**L160e-7.5 A**	**L160e-9 A**	**L200e-7.5 A**	**L200e-9 A**
Maximum working pressure		bar g	7.5	9	7.5	9
Minimum working pressure		bar g	5,0			
Ambient temperature - min/max		°C	1 to 45			
5 bar	FAD*	m^3/min	**33,11**	**31,86**	**40,69**	**38,71**
	Total input power* (P spec. - kW min/m³)	kW	165,89 (5,01)	160,09 (5,03)	210,16 (5,16)	198,48 (5,13)
6 bar	FAD*	m^3/min	**33,09**	**31,84**	**40,67**	**38,69**
	Total input power*	kW	174,93 (5,29)	169,22 (5,31)	221,36 (5,44)	209,13 (5,41)
7 bar	FAD*	m^3/min	**33,08**	**31,82**	**40,65**	**38,67**
	Total input power*	kW	184,13 (5,57)	178,44 (5,61)	232,61 (5,72)	219,87 (5,69)
7.5 bar	FAD*	m^3/min	**33,04**	**31,81**	**40,02**	**38,66**
	Total input power*	kW	190,64 (5,77)	183,10 (5,76)	234,10 (5,85)	225,28 (5,83)
8 bar	FAD*	m^3/min		**31,81**		**38,66**
	Total input power*	kW		187,78 (5,90)		230,74 (5,97)
9 bar	FAD*	m^3/min		**30,43**		**37,30**
	Total input power*	kW		188,30 (6,19)		232,66 (6,24)
10 bar	FAD*	m^3/min				
	Total input power*	kW				
11 bar	FAD*	m^3/min				
	Total input power*	kW				
12 bar	FAD*	m^3/min				
	Total input power*	kW				
13 bar	FAD*	m^3/min				
	Total input power*	kW				
Total input power at no load, fan switched off		kW	49,2	45,0	61,2	56,5
Male rotor speed		rpm	1931	1777	2355	2190
Approx. discharge temperature of air above ambient		°C	8	7	8	7
Free field noise level **		dB(A)	77		78	
Electrical Data						
Nominal motor rating		kW	160		200	
Nominal voltage [tolerance] (Frequency)			380V[±10%] / 460V[±10%] (60 Hz)			
Full load current max. at 380V / 460 V		A	360 / 320		474 / 397	
Starting current (max. % of full load current)		%	220 / 213		319 / 317	
Standard drive motor detail			IP55 / IE-4 - IEC 60034-2-1 // IP55/ IE-3 - IEC 60034-2-1 ****			
Drive motor speed		rpm	3600			
Fan motor rating (Air / Oil - cooler) at 380V / 460V		kW	2,2 / 4,0 (IE-3)		2,2 / 4,0 (IE-3)	
Suggested cable size at 380V / 460V ***		mm^2	2x 3x 95 PE 95 / 2x 3x 70 PE 70		2x x3 150 PE 150 / 2x x3 95 PE 95	
Suggested fuse rating at 380V / 460V (type gG)		A	2x 3x 224 / 2x 3x 200		2x 3x 315 / 2x 3x 250	
Cooling Data						
Machine Ventilating capacity max.		m³/min	20		30	
Ventilating fan capacity max (Air / Oil - cooler)		m^3/min	100 / 220		100 / 220	
Heat rejected by ventilating fan (max. % of actual input power)		%	95			
Size of cooling air inlet aperture		mm	1700 x 1520			
Size of cooling air outlet aperture		mm	1790 x 420			
Approx. cooling air temp. above ambient (at max. power)		°C	18		22	
Max. allowable pressure drop in duct (at ambient 35°C / 45°C)		Pa	90 / 40		70 / 20	
Weights, Dimensions and Capacities Data						
Compressor oil capacity		l	140			
Oil carry over		mg/m^3	< 3			
Compr. air delivery connection (male screwed thread)			Flansch EN 1092-1 / 13 / DN 80 / PN 16 / P250GH			
Weight		kg	4542		4765	
Package dimensions L x W x H		mm	2907 x 2071 x 2193			

* Data measured and stated in accordance with ISO1217 4rd Edition Annex C and at the following conditions:
Air Intake Pressure: 1 bar a / 14.5 psia
Air Intake Temperature: 20°C / 68°F
Humidity: 0% (dry)
** Measured in free field conditions in accordance with the ISO 2151, tolerance ± 3dB(A).
CompAir policy is one of continuous improvement and we therefore reserve the right to alter specifications without prior notice.
*** max.30°C / max. 50m / Copper
**** all above data are based on IE4 motors. In the case of 380V/60Hz standard motor is class IE3 and the power consumption and specific energy increase by 0,7 %