RUSTENBURG OPERATIONS

VENTILATION DEPARTMENT

SCOPE OF WORK FOR THE MANUFACTURE AND REPAIR OF ELECTRICALLY DRIVEN AUXILIARY FANS FOR UNDERGROUND PLATINUM MINE APPLICATION

Approved By

Name & Surname	Designation	Date	Signature
James van Rensburg	Group Ventilation Manager		

Reviewed By

Name & Surname	Designation	Date	Signature
Leon du Toit	Ventilation Manager		
Ishmael Taunyane	Ventilation Manager		
Simon Madibane	Ventilation Manager		
Albert Viljoen	Ventilation Manager		

Authored By

Name & Surname	Designation	Date	Signature
James van Rensburg	Ventilation Manager		

Recommended By

Name & Surname	Designation	Date	Signature
James van Rensburg	Group Ventilation Manager		

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1. BACKGROUND AND TECHNICAL MOTIVATION

The historical principles applied to the procurement and repair of Impala's electrically driven, in-line axial flow fans was to select, through a process of elimination, a competent, established vendor and enter into a long-term relationship with such a vendor. This approach has traditionally ensured a reliable supply of repaired fans with minimal disruption, as well as stable pricing structures based on new and repaired fan order volumes, augmented by regular market surveys to ensure competitive prices.

More recently and in line with achieving the aims of the Mining Charter, there has been a shift towards procurement of equipment and services from competent local (Tier 1) suppliers and encouraging the use of multiple suppliers. This approach reduces procurement risk and ensures competitive pricing.

Axial Flow Development and Empowerment Company, has been the sole supplier of new and repaired electrically driven, in-line axial flow fans (as well as fan silencess) to Impala for more than 20 years.

The last formal tender for the manufature and repair of electrically driven, in-line axial flow fans was conducted in early 2013 and based on the lowest bid, was again awarded to Axial Flow Development and Empowerment Company on 26 June 2013. As Impala Platinum procurement contracts are valid for 3 years, the Axial Flow Development and Empowerment Company contract was again reviewed in 2016 and the contract again extended for a further 3 years. The contract is again up for review. This document is aimed at providing guidelines for the manufacture and repair of the various types of electrically driven, in-line axial flow fans required for use at Impala.

2. OBJECTIVE

This tender process is conducted for the following reasons:

- The contract for the manufacture and repair of electrically driven, in-line axial flow fans deployed at Impala's operations is due for review.
- To ensure that, as far as reasonably practicable, Impala's procurement process for the manufacture and repair of in-line axial flow fans meets the requirement of the Mining Charter.
- To encourage greater diversification and transformation of supply,
- To ameliorate the procurement risk of a sole supplier to Impala,
- To provide a means to identify and where applicable, incorporate new designs and technology in the manufacture and repair of standard electrically driven, in-line axial flow fans,
- To ensure that, as far as reasonably practicable, manufactured and repaired electrically driven, in-line axial flow fans meet the requirements of Impala's Hearing Conservation Programme and the requirements of the Mine Health and Safety Council (MHSC) noise milestone.
- To ensure competitive pricing for fan manufacture and repairs.

3. TERMS, ABBREVIATIONS AND DEFINITIONS

Term	Definition
Fan	For the purpose of this document, shall mean electrically driven, in-line axial flow fans of varied type, diameter and motor capacity as depicted in Table 1
AISI	American Iron and Steel Institute
Approved	Approved, in writing, by a competent Engineer, employed by Impala Platinum
BS	British Standard
MHSC	Mine Health and Safety Council
Inspection Agency	Means a third-party inspection agency appointed by Impala Platinum
Manufacturer	Shall mean the Contractor manufacturing electrically driven, in-line axial flow fans
Repairer	Shall mean the Contractor conducting repairs on electrically driven, in-line axial flow fans

4. SCOPE OF WORK

This Scope of Work (SoW) details the requirements for the manufacture and repair of electrically driven, in-line axial flow fans of varied type, diameter and motor capacity as depicted in Table 1.

4.1. General requirements

4.1.1. The Manufacture of fans shall be conducted according to Impala's specifications,

4.1.2. The manufacture and Repair of fans shall be conducted according to Impala's specifications,

4.1.3. The complete fan shall be tested on the Manufacturer's/Repairer's ventilation fan test column.

4.1.4. All fan tests shall be conducted within the pressure/volume envelope (5% less and 5% more) of the original design performance curve for the specific fan size.

4.1.5. The Manufaturer/Repairer shall notify Impala's Engineer reponsible for quality control where the performance curve of a tested fab is outside the given envelope.

4.1.6. Fans for repair shall be collected from Impala's central refurbishment centre,

4.1.7. Manufactured/Repaired fans shall be delivered, complete with a performance curve for each fan, to Impala's central refurbishment centre.

4.1.8. The Manufacturer/Repairer shall ensure that workmanship, materials and quality assurance applied for the Manufacture/Repair of fans are in accordance with the latest engineering practice to ensure the fans operate at the designed performance when installed underground.

4.1.9. Fans supplied by the Manufacturer/Repairer shall withstand man and machine handling as described in the mine's standard procedure for transportation from surface to final installation in the underground working place. Notwithstanding the afrementioned, all manufactured and repaired fans shall operate in normal underground conditions.

4.1.10. All fans shall operate up to an ambient temperature of 50ºC and at a saturated air

density of 1.2 kg/m³. The electrical power supply to fans will be 525 volt nominal, 3 phase, 50Hz having and a voltage range of 475 to 575 volts.

4.1.11. The Repairer shall keep records of the history of all repairs conducted to each fan and submit a monthly summary report to the Refurbishment Centre and Ventilation Department reflecting the analysis of repairs conducted for each month.

4.1.12. The sub-contracting of any part of the manufacture or repair shall not be permitted unless approved by Impala. Details of sub-contractors shall be be provided for approval at the time of tender.

4.1.13. All materials to be used for winding of the module shall be in accordance with the requirements of SANS 10242. Part rewinds shall not be permitted.

4.2. Tools and Equipment

4.2.1. The manufacturer/repairer shall ensure that acceptable tools and measuring apparatus shall be be provided at their premises for the manufactre/repair of fans. Such tools and measuring apparatus may include but are not limited to:

- Facilities for the removal of windings,
- Burn-out oven,
- Sand blasting,
- Varnish dipping tanks,
- Vacuum impregnation system,
- Drying ovens,
- Spray paint booth, and
- A fan test column and relevant instrumentation for the accurate measurement of fan performance.

4.3. Balancing

4.3.1. Balancing of the fan impeller shall be conducted in accordance with specification, BS 4675 part 1.

4.3.2. Fan and rotor assemblies shall be tested on an approved test rig and in accordance with an approved testing procedure.

4.3.3. Fan and rotor assemblies shall be balanced to reduce the vibration peak velocity to a value less than 2.0 mm/s or root mean square (rms) of 1.414 mm/second, filtered and unfiltered on both end flanges.

4.3.4. Vibration levels shall be measured in accordance with the requirements of BS 4675 part 1 and part 2.

4.4. Noise Levels

4.4.1. The MHSC may, from time to time establish milestones to limit occupational exposure to noise and to eliminate Noise Induced Hearing Loss (NIHL). To ensure that a standard approach to noise measurements for milestone compliance is followed, the Minerals Council of South Africa (MCSA) issued a Guidance Note for Noise measurements (a copy of the guideline is available from Impala, on request). The manufacturer/repairer shall ensure that noise levels measured in accordance with the guideline, meet the following requirements:

- The noise level emitted by a sound attenuated fan shall (as far as reasonably practicable, not exceed an L_{aeq8h} of 104 dB(A) when measured in a free field.

- The noise level emitted by an unattenuated fan shall, when fitted with standard silencers, one each on the intake and outlet side of the fan, not exceed an L_{aeq8h} of 104 dB(A) when measured in a free field.

4.5. Fans

4.5.1. The fans shall be assembled such that the union of the electric motor and the fan casing is conducted after all welding has been completed. No welding shall be conducted on any component after the fan motor has been fitted to the casing.

4.5.2. A reinforced impeller track shall be provided for all fans with a diammeter equal to or larger than 915mm,

4.5.3. Fans, 75kW and larger shall be fitted with a bolt-on reinforced impeller track of not less than 10mm complete with flanges (as stipulated in Table 1) welded on both sides of the impeller track.

4.5.4. A reinforced impeller track shall be provided for all sound attenuated fans and Durafans™.

4.5.5. Flanges shall be welded to both sides of the fan casing and shall comply to the following:

- Circular flanges shall be manufactured from the same material as the end flanges.
- Circular flanges shall be placed such that it prevents damage to the terminal box when the fan is rolled,
- Circular flanges on sound attenuated fans shall be welded in the centre of the impeller track.
- The flange holes shall conform to the requirements as stipulated in table 1.
- Flange thickness shall conform to the requirements as stipulated in table 1.

4.5.6. Impeller blades and guide vanes shall be manufactured from mild steel with a minimum yield of 280 MPa. Impeller blades shall be continuously welded to a fabricated mild steel hub.

4.5.7. The boss shall be continuously welded to the hub and bored concentric with the hub after welding. The boss shall have tapped holes which shall be used when withdrawing the impeller from the motor shaft.

4.5.8. The manufacturer/repairer shall submit the welding procedure to Impala for approval. Such procedure shall include but not be limited to the following:

- Preparation,
- Consumables
- Pre/post heat treatment
- Interpass temperature
- Number and method of weld deposit lays,
- Jigging (where required), and
- Non Destructive Testing (NDT)

4.5.9. The impeller shall be attached to the motor shaft by means of a bolt fixing which is locked to prevent the impeller detaching from the impeller shaft.

4.5.10. The clearance between the impeller blades and the casing shall be consistent and not less than 1.5mm and not more than 3mm.

4.5.11. The impeller fairing shall form an integral part of the hub.

4.5.12. Inlet and outlet screens shall be fitted to all fans. Screens shall comprise a 50mm square mesh of 5mm wire welded to a circular steel rim.

4.5.13. Fan screens shall be manufactured and fitted to a high standard ensuring that the screen remains in tact during transportation to site and during normal operation.

4.5.14. The screens shall butt against a cruciform section comprising 50 mm x 6 mm flat bar. The 50mm section of the flat bar shall lay along the axis of the fan. The manufacturer/supplier shall submit to Impala, a procedure for the manufacture of the screens.

4.5.15. A terminal box, manufactured from 5 mm mild steel shall be fitted to the fan casing and must be protected in the event that the fan is rolled from one position to another.

4.5.16. Terminal clearances in the terminal box shall be no less than 20 mm.

4.5.17. A 100 mm galvinised retention chain shall be welded to the terminal box cover. Weld points shall be painted with a zinc coat to prevent rust.

4.5.18. The motor lead tube shall be manufactured from galvanised steel and effectively sealed to prevent ingress of water to the motor. A rigid capillary tube shall be installed hrough the seal in the lead tube, protruding a minimum of 20 mm into the terminal box.

4.5.19. Fans, 75kW and larger shall be wound with 6 leads in the terminal box to allow for Star/Delta starting.

4.5.20. The following indicators shall be welded to the casing:

- Fan number (as stipulated on the order), in 4mm thick and 75mm high characters.
- Motor rating, in 4mm thick and 75mm high characters.
- Impeller rotation and airflow direction in 4mm thick characters.

4.5.21. Fan motor dimensions shall meet the requirements of SANS 10948.

4.5.22. Lifting lugs shall be welded onto the casing and shall be designed in accordance with the weight of the specific fan. The lugs must be aligned to the terminal box ensuring that the terminal box will be positioned on the hanging wall side when a fan is installed.

Fans shall be transported horizontally with the lifting lugs facing upwards ensuring the impeller is free to rotate. Transportation of fans in a vertical position , i.e. on the flanges, is prohibited.

4.5.23 All struts, bolts and nuts used to attach the motor and other components to the casing shall be installed in such a manner to prevent loosening due to vibration and handling.

4.6. Electric Motors

4.6.1. Motor dimensions shall be in accordance with the requirements of SANS 60529.

4.6.2. The degree of protection of the enclosure shall be IP55 rated in accordance with the requirements of SANS 60529.

4.6.3. The motor frame and end shields shall be machined from steel or cast iron. The design of the end shields shall make provision for the easy removal when dismantling the motors.

4.6.4. The depth of the mounting holes in the casing shall be a minimum of 1,25 times the hole diameter.

4.6.5. Motors shall be designed to minimise the distance between the bearings as far as it is practically possible. The suggested maximum ratio of rotor diameter to rotor length is 1:1,4.

4.6.6. All bolts and nuts used in the motor shall be positively locked to prevent loosening due to vibration whilst in service.

4.6.7. Bearings shall comprise one deep groove ball bearing at the non-drive end and one cylindrical roller bearing at the drive end. The cylindrical roller bearing shall have two integral flanges on the inner ring and a flangeless outer ring.

4.6.8. Bearings incorporating seals or shields shall not be adopted.

4.6.9. Bearings shall have a design life of 100 000 hours and shall run for 25 000 hours without re-lubrication.

4.6.10. Bearing journals and housings shall be machined in accordance with the bearing manufacturer's recommended surface texture and dimensional tolerances.

4.6.11. Bearing housings shall incorporate cavities on both sides of each bearing. These cavities shall be capable of holding twice the grease capacity of the bearing and shall extend no further than the inner shoulder of the outer race of the bearing to ensure grease re-circulation.

4.6.12. Bearings shall be heated by means of induction heating before locating on the journals. The induction heater shall be approved by the bearing manufacturer and shall have a demagnetising facility. The bearing temperature shall not exceed 100°C.

4.6.13. Bearings shall be located to prevent axial movement of the bearing on the shaft by means of circlips. Alternative arrangements must be approved by Impala.

4.6.14. Bearings and housings shall be cleaned of all reserving/packaging oil or grease.

4.6.15. Bearings shall be packed full and housing cavities 30% full of grease.

4.6.16. The shaft seal shall be of the flexible lip type either fixed to the housing and running on a hardened and ground shaft sleeve or fixed to the shaft and running on the motor housing. Both end covers shall have an “O” ring seal or gasket fitted. Seal material shall be resistant to attack by normal underground contaminants.

4.7. Winding

4.7.1. **Insulation materials and class**: All materials used in the machine shall be of Class 'F' or Class 'H' grade as specified in accordance with BS 2757 or as approved by Impala. The Manufacturer/Repairer shall obtain approval in writing for alternative insulation should it be decided to depart from the insulation listed.

4.7.2. The conductor shall comprise of high conductivity copper to SANS 60317 Specifications for particular types of winding wires, Part 8: Polyesterimide enamelled round copper wire, class 180 of round section, covered with a Grade 2 Polyester based enamel having a temperature index of 200º C.

4.7.3. Tests shall be carried out by the copper wire manufacturer on all copper conductors to prove compliance with SANS 60851 Part III Section 7 and shall bear the SABS mark. Coils shall be wound in phase groups.

4.7.4. **Varnish system**: to be used shall be either

- Double dip varnish method, or
- Vacuum pressure impregnation without overhang taping, as described below.

Acceptable materials and their applications for a double dip varnish impregnation system are:

- **Slot liners, separators and caps**: shall be three ply composites of Nomex and polyester of suitable dimensions. Slot liners shall comprise a composite where each Nomex paper layer is not less than 80 microns in thickness.

- **Overhang phase insulation**: shall be a composite of three ply uncalendered Nomex and polyester to effectively insulate the ends of each phase group.
- **Intercoil and end connections**: oil and end connections: after brazing with silfos shall be double sleeved using silicone or acrylic coated glass braid or knitted sleeving.The sleeve shall extend at least 50mm on each side of the joint.
- **Slot wedges**: shall be synthetic resin bonded woven glass fabric laminated sheet to BS 3953 grade EP-5 not less than 0.5 mm thick. The wedge shall be adequately dimensioned to secure the coil in the slot and shall extend beyond the ends of the core to the ends of the slot liners.
- **Coil end flexible leads**: shall be connected to the machine terminals by flexible stranded copper conductor cable with a cross sectional area not less than the machine winding to which it is connected. The cable insulation shall be silicone rubber with either a 'built in' synthetic yarn braid or an additional sleeve of synthetic yarn over the cable for added mechanical strength.
- **Bracing of endwinding**: shall be woven or braided polyester or glass tying cord lashed around the end windings to provide adequate bracing.
- **Varnishing**: of the complete core and windings shall be by dipping and part baking and then re-dipping and fully curing in a manner recommended by the varnish manufacturer. Acceptable varnishes are:
    - ISONEL 31
    - ISONEL 51
    - DOLPHS HI-THERM BC 359
    - DOLPHON VCC 1105 Polyester resin.

4.7.5. **Vacuum pressure impregnation with full winding overhang taping**: acceptable materials and their applications for a vacuum pressure impregnation with the winding overhang fully taped system are:

- **Slot liners, separators and caps**: shall be three ply composites of Nomex and polyester of suitable dimensions. An additional slot liner of uncalendered Nomex shall be inserted inside the three ply composite liner. Alternatively, a three ply composite of calendered Nomex, polyester, and uncalendered Nomex may be used provided the calendered Nomex side is fitted against the iron core. Once all coil conductors have been inserted, the slot liners shall be folded over and the stator slot wedge fitted above the slot liners in order to seal the coil in the slot portion. Slot liners shall comprise a composite where each Nomex paper layer is not less than 80 microns in thickness.
- **Overhang phase insulation**: on each coil shall be by fully taping around the overhang portion with a woven polyester tape at least 20 mm into and around the slot liner/wedge to seal the slot portion. The tape shall allow the impregnating resin to penetrate the slot and overhang portions under pressure and retain the resin whilst being cured. No additional phase insulation shall be necessary.
- **Intercoil and end connections**: after brazing with silfos shall be double sleeved using silicone or acrylic coated glass braid or knitted sleeving. The sleeve shall extend at least 50 mm on each side of the joint and be taped from end to end with a woven polyester tape to fully seal the connection when impregnated.
- **Slot wedges**: shall be synthetic resin bonded woven glass fabric laminated sheet to BS 3953 grade EP-5 not less than 0.5 mm thick. The wedge shall be adequately dimensioned to secure the coil in the slot and shall extend beyond the ends of the core to the ends of the slot liners.

- **Coil end flexible leads:** shall be connected to the machine terminals by flexible stranded copper conductor cable of a cross sectional area not less than the machine winding to which it is connected. The cable insulation shall be silicone rubber with either a 'built in' synthetic yarn braid or an additional sleeve of synthetic yarn over the cable for added mechanical strength.
- **Bracing of endwinding**: shall be woven or braided polyester or glass tying cord lashed around the end windings to provide adequate bracing.
- **Vacuum pressure impregnation**: of the complete core and windings shall be in a manner recommended by the resin manufacturer. Acceptable resins are:
    - **ISOLA 3308**
    - **DOLPHON VCC 1105**
    - **EPOXYLITE 478 E**
    - **EPOXYLITE 498**

4.7.6. Vacuum pressure impregnation without overhang taping: acceptable materials for the vacuum pressure impregnation without overhang taping system are:

- **Slot liners, separators and caps**: shall be three ply composites of Nomex and polyester of suitable dimensions. An additional slot liner of uncalendered Nomex shall be inserted inside the three ply composite liner. Alternatively, a three ply composite of calendered Nomex, polyester, and uncalendered Nomex may be used provided the calendered Nomex side is fitted against the iron core. Once all coil conductors have been inserted, the slot liners shall begfolded over and the stator slot wedge fitted above the slot liners in order to seal the coil in the slot portion. Slot liners shall comprise a composite where each Nomex paper layer is not les than 80 microns in thickness.
- **Overhang phase insallation**: shall be uncalendered Nomex or polyester mat, installed so as to effectively insulate the ends of each phase group.
- **Intercoil and end connections**: after brazing with silfos shall be double sleeved using silicone or acrylic coated glass braid or knitted sleeving. The sleeve shall extend at least 50 mm on each side of the joint.
- **Slot wedges**: shall be synthetic resin bonded woven glass fabric laminated sheet to BS 3953 grade EP-5 not less than 0.5 mm thick. The wedge shall be adequately dimensioned to secure the coil in the slot and shall extend beyond the ends of the core to the ends of the slot liners.
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- **Bracing of endwinding**: shall be woven or braided polyester or glass tying cord lashed around the end windings to provide adequate bracing.
- **Vacuum pressure impregnation**: of the complete core and windings shall be in a manner recommended by the resin manufacturer to give a high build on the winding overhang section and to fully seal the stator slot portion. An acceptable resin is:
    - EPOXYLITE 498

4.8. QUALITY ASSURANCE REQUIREMENTS

4.8.1. Quality plan

Manufacturers/Repairers shall compile and submit a quality management plan for consideration by Impala. The quality plan shall list all major operations, specifications, verifications (including third party verifications), test methods and include acceptance/rejection criteria.

4.8.2. Testing and Performance

4.8.2.1. The Manufacturer/Repairer shall provide a fan test facility sufficient in design and capacity, to test all sizes of fans to be delivered to Impala.

4.8.2.2. The Contractor shall supply documentation containing the following:

- Drawings of the fan test column and its ancillary components,
- The fan test procedure,
- Quality control in terms of maintenance and caibration of testing equipment.

4.8.2.3. Qualifications and experience of person/s conducting fan testing.

4.8.2.4. The complete fan once assembled shall be installed on the Manufacturer's/Repairer's ventilation test column.

4.8.2.5. The fan shall be run at its rated voltage and frequency at full speed.

4.8.2.6. Testing shall be carried out in accordance with the Original Equipment Manufacturers (OEM) design requirements and BS848 Pt. 1 class "B:" tolerance.

4.8.2.7. The vanes in the test column shall be varied and changes in air volume and pressure shall be recorded.

4.8.2.8. A performance curve shall be produced for each fan tested.

4.8.2.9. The test fan shall perform within the Pressure/Volume envelope of the specific fan.

4.8.2.10. The Manufacturer/Repairer shall notify Impala where the performance curve of the tested fan is outside the design envelope.

4.8.3. Vibration

4.8.3.1. The fan shall be mounted on an approved test rig.

4.8.3.2. The fan shall run on its rated voltage supply at full speed.

4.8.3.3. Unfiltered vibration measurements shall be taken in the radial and axial planes at the fan casing.

4.8.3.4. The maximum acceptable velocity shall be 2.8mm/s (peak).

4.8.4. Access

Authorized representatives from Impala shall have access, during normal working hours, to those parts of the manufacturing and/or repair facilities engaged in the manufacture and/or repair of articles to this specification. Authorized representatives from Impala shall have access to witness any stage of manufacture, repair, testing and to inspect relevant documentation. Impala shall be authorized to reject any items not complying with the requirements of this specification. In the event of a dispute aminating from the interpretation of test results, the decision from Impala shall be final.

4.8.5. **Certificates of Compliance**

Every fan manufactured/repaired shall be assessed by the Manufacturer/Repairer whereafter a test certificate stating that the fans comply to the provisions of this specification shall be issued. The test certificate shall include, as a minimum, the following information:

- Fan number(s)
- Mechanical test results
- Result of audible test on bearing
- Electrical test results
- Motor current in each phase compared with the reference standard.
- Motor temperature rise when compared with reference standard.
- Balancing test results
- Performance test conducted in accordance with a method approved by Impala and corrected to an air density of 1.2 kg/m^3.

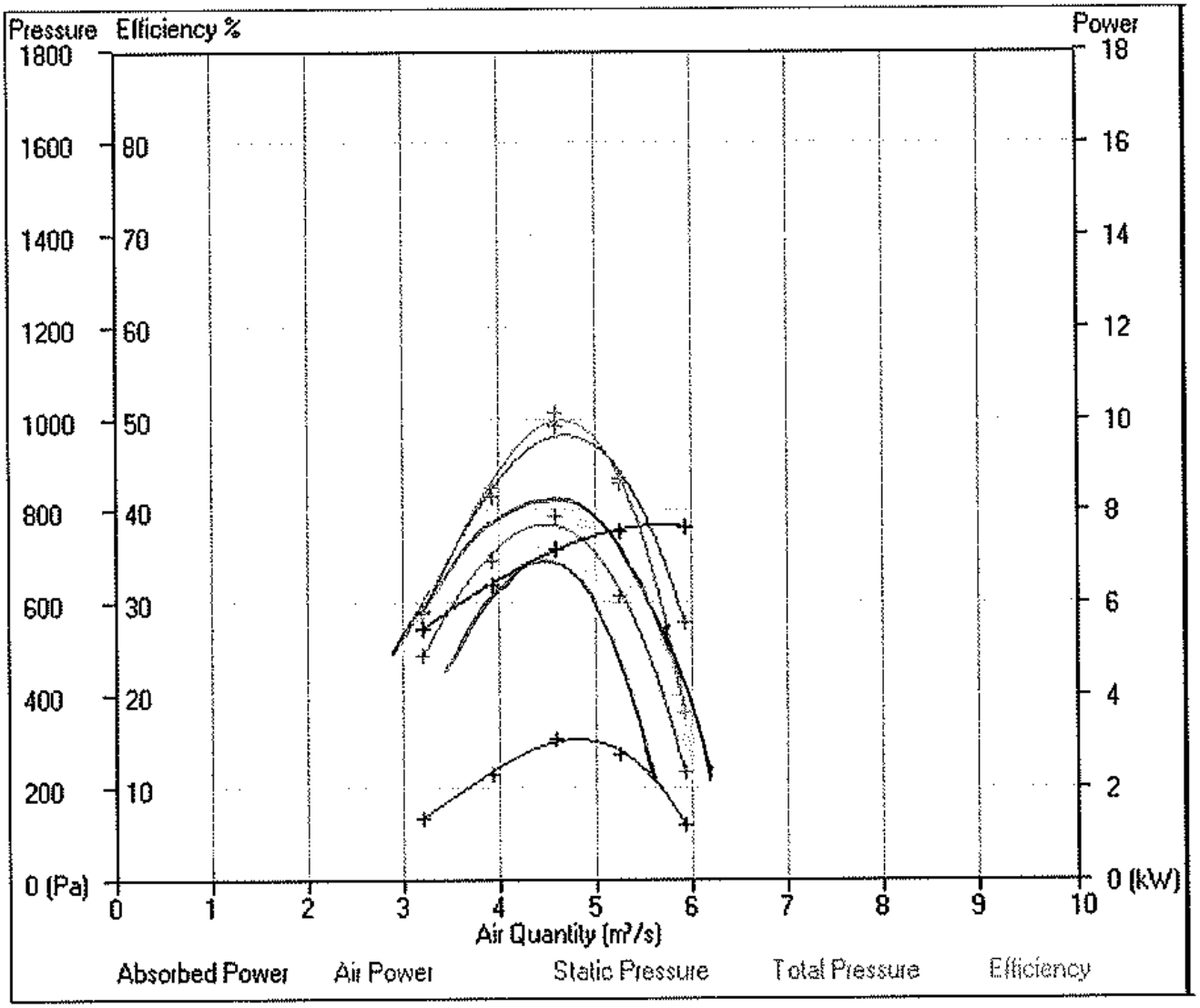
4.8.6. **Transportation**

Fans shall be transported situated in the normal operating position (i.e. fan axis in the horizontal plane) with fan axis in direction of travel and impeller free to rotate. Transportation with operating axis vertical (i.e. on flanges) is not permitted.

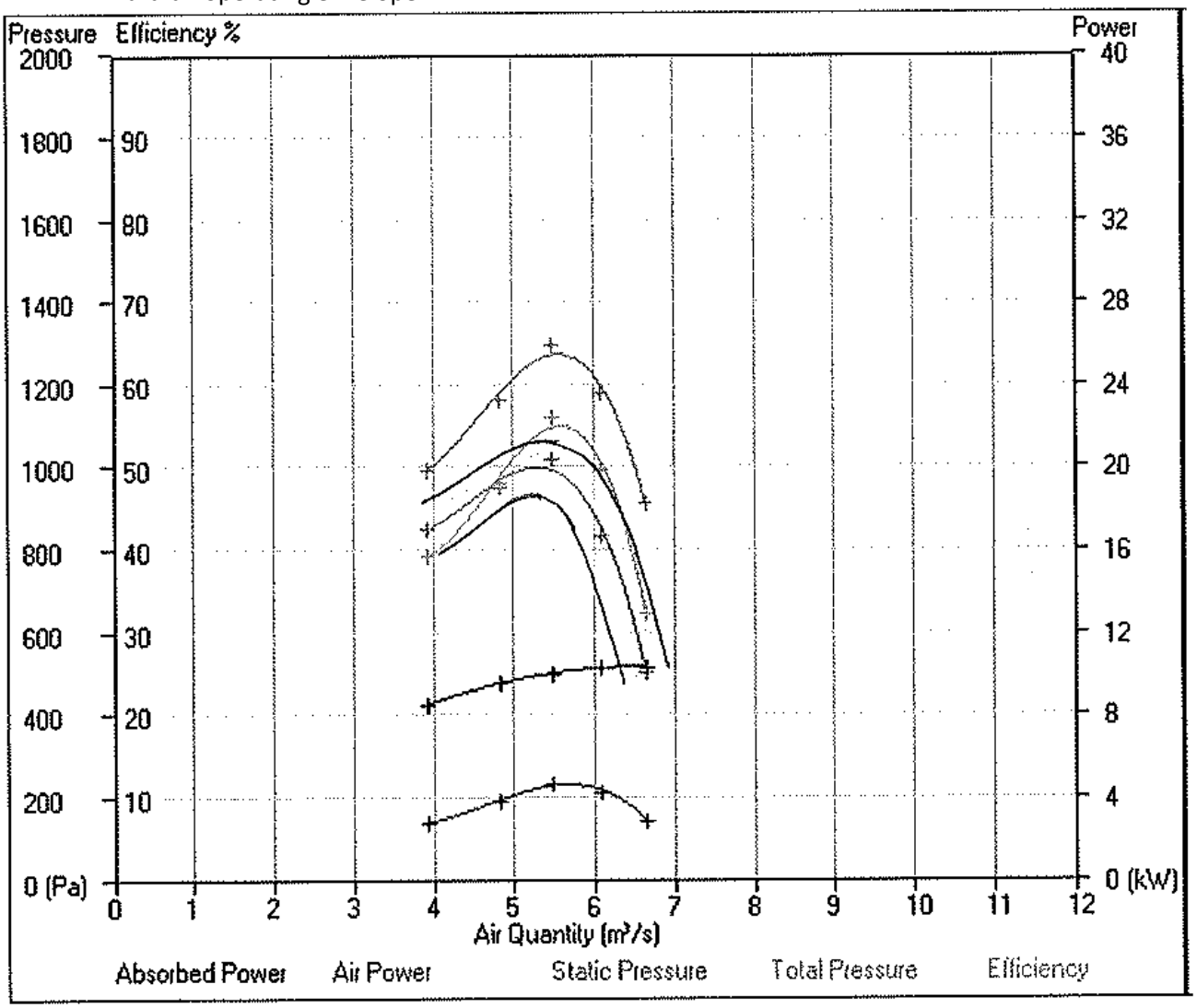
Table 1

Rating of fan (kW)	Fan type	Motor type	Inner diam. (mm)	Weight (kg)	Fan duty (m^3/s)	Fan duty (Pa) @1.2kg/m^3	Flange thickness (mm)	Flange width (mm)	No. of flange holes (n)	Pitch circle diameter (mm)
0.75	Standard	2 pole	306	40			6	40	4	356
4.0	Standard	2 pole	406	120	2.2	310	8	50	6	457
4.0	Standard air jet	2 pole	406							
4.0	Sound attenuated	2 pole	406	180						
4.0	Sound attenuated Airjet	2 pole	406							
4.0	Durafan	4 pole	406	1200						
7.5	Standard	2 pole	570	320	3.0	980	10	50	9	622
7.5	Sound attenuated	2pole	570	380						
7.5	Sound attenuated Airjet	2 pole	570	400						
7.5	Durafan	4 pole	570	1350	4.5	780				
11	Standard	2 pole	570	350	4.0	1050	10	50	9	622
11	Sound attenuated	2 pole	570	430						
11	Sound attenuated Airjet	2 pole	570							
11	Durafan	4 pole	570	1380	5.5	1000				
15	Standard	2 pole	570	400	4.5	1100	10	50	9	622
15	Sound attenuated	2 pole	570	440						
15	Standard Airjet	2 pole	570	460						
15	Sound attenuated Airjet	2 pole	570	470		1120				
15	Durafan	4 pole	570	1380	5.5					
22	Standard	2 pole	760	485	7.5	1050	10	50	12	622
22	Sound attenuated	2 pole	760	540						
22	Sound attenuated Airjet	2 pole	760							
22	Durafan	4 pole	760	1450	8.0	1500				
45	Standard	2 pole	760	640	10.5	1600	10	50	12	812
45	Sound attenuated	2 pole	760	820						
45	Durafan	4 pole	760	1480	10.5	1700				
75	Standard	2 pole	1016	750	18.0	2300	12	50	15	1067
75	Sound attenuated	2 pole	1016	960						

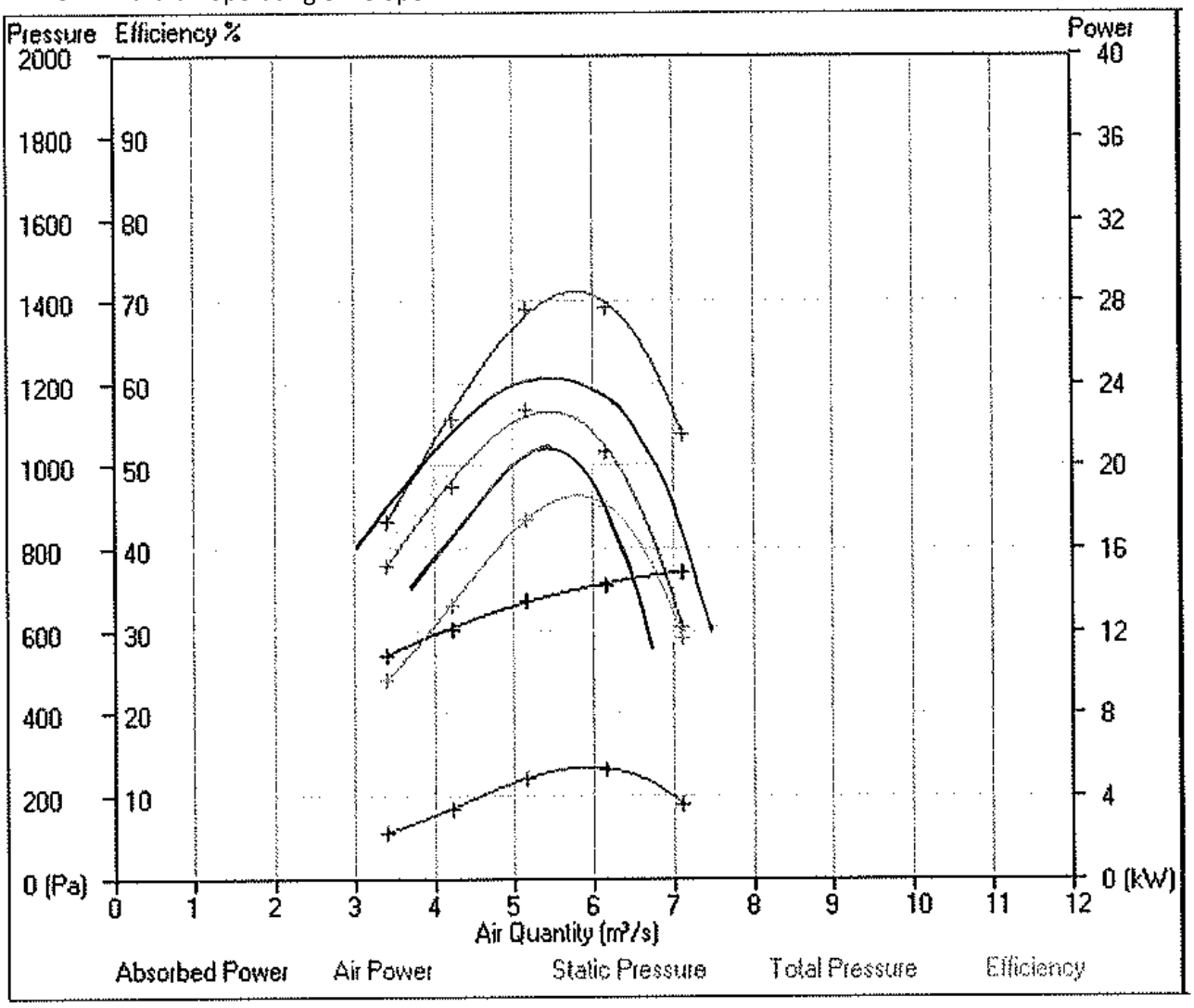
7.5kW Durafan operating envelope



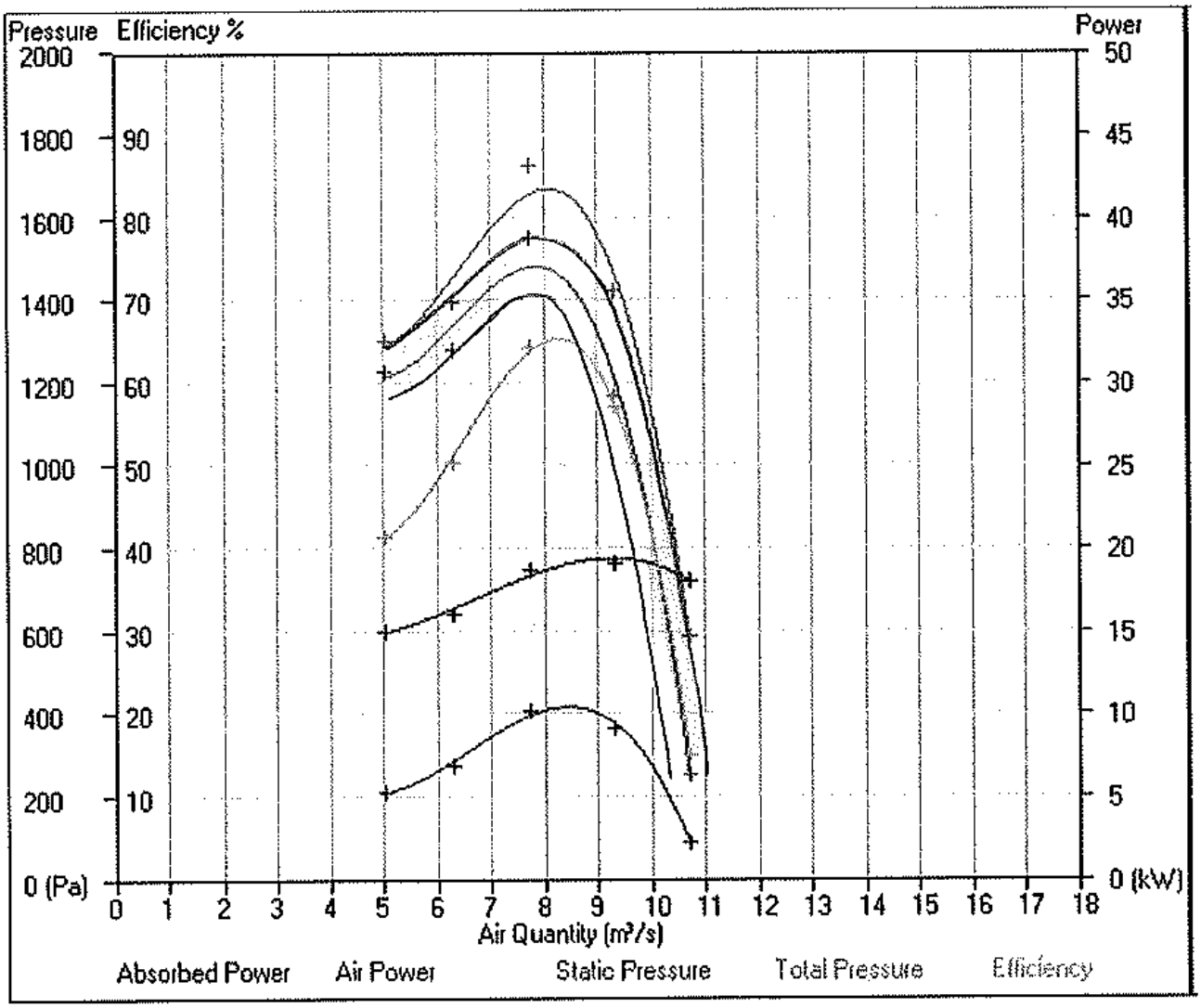
11kW Durafan operating envelope



15kW Durafan operating envelope



22kW Durafan Operating Envelope



45kW Durafan Operating Envelope