

Standard Operating Procedure

PAWS

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| SOP Filename | PAWS Pneumatic System |
| SOP Description | A guide to preparing and operating the Physical Artefact for Well-being Support (PAWS) Pneumatic System |

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1. Acronyms and Definitions

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| SOP | Standard Operating Procedure |
| PAWS | Physical Artefact of Well-being Support |

2. Safety

Researchers should ensure they have appropriate ethical approval.

This SOP should be read in conjunction with Research Biopac V2.0 . Ensure that you have had appropriate training¹ and have read the relevant operator's manual/s and any specific documentation prior to using the equipment or undertaking the following task.

Users should follow the General lab rules document.

Risk Assessment

Researchers should ensure they have read the generic PAWS risk assessment and conducted a bespoke risk assessment for their research before recruiting participants.

<https://wiki.bath.ac.uk/display/EO/Risk+Assessments>.

3. Purpose

This SOP centres around the Electric Air Compressor operation, of which the [user manual can be found here](#). This Electric Air Compressor is the centrepiece of the Physical Artefact for Well-being Support (PAWS) Pneumatic System, which enables the actuation of an inflatable device.

4. Background

PAWS is used in research activities that support the physical manifestation of breath-based biosignals. The product should only be used as described in this document, of which operation of the compressor can be found [here](#). Please read the user manual and other supplied documentation thoroughly before using the product.

PAWS consist of

- Biopac MP 160: please see here for [Standard Operating Procedure](#)
 - One MP 160 Data Acquisition Unit
 - One RSPEC-R (Respiration and electrocardiogram (ECG)) Bionomadix module
 - One BN-TX RSPEC-3.0 Bionomadix receiver
- Air Compressor
- Arduino Bio-signal processing and Solenoid Controller Circuit
- Balloon (cotton outer) and tubing
- Laptop with associated software

5. Scope

This procedure applies to any researcher who uses the PAWS in the University of Bath, Department of Psychology

¹ Discussions with the Experimental Officer/Technician will decide the level and type of training required

6. Procedure

Gaining Access

Access to the equipment can be gained by discussing with the Research Hub Support Team psy-experimental-officer@bath.ac.uk.

Connecting the components

Air Compressor: please see here for [user manual](#)

Starting Procedure for Air Compressor

1. Check that the power switch is in the OFF position.
2. Close the drain valve and ensure the air filter is installed.
3. Close the drain valve.
4. Plug the compressor in to a working plug socket.
5. Turn the power switch to the ON position.
6. Allow the motor to run and fill the tank until the motor turns off.

Stopping Procedure for Air Compressor

1. Turn the power switch to the OFF position.
2. Unplug the compressor.
3. Reduce the pressure in the air tank through the air supply hose.

Draining the Air Tank

1. You should drain the tank at the end of each day.
2. Ensure drain knob is pointed away from any exposed electronics
3. With compressed air in the tank, slowly turn the drain knob to the open position
4. If there is any air, or water in the tank it will drain out
5. Once empty, turn the drain knob to the closed position.
6. Empty any water into the sink, if the device is not located near a sink. Carry the container carefully to the nearest sink. Any spills must be cleaned up immediately.
7. Draining the tank reduces the risk of corrosion inside the tank.

Biopac: please see here for [Standard Operating Procedure](#)

Starting Procedure for Biopac

1. Check that the power switch on the plug is in the ON position.
2. Check that the power switch on the MP 160 is ON.
3. Check that the power switch on the BN-TX RSPEC-3.0 is ON.
4. Check that the status light flashes green (the light on the module will also change to a solid state)

Stopping Procedure for Biopac

1. Turn off all power switches

PAWS

Starting Procedure for PAWS

1. Check that you have filled the air compressor and that the Biopac system is linked
2. Ensure the balloon is placed inside a clean cotton outer and securely attached to the tubing. The tubing should be secured to be out of the way, with minimal trip hazard risk.

3. Open the PAWS python operation program (yet to be made)
4. Follow instructions

Setting up a participant

The participant will need to wear a chest sensor to collect the respiration data. In an ideal situation the participant will put the strap on themselves. A guidance document is provided to show the participant where the chest strap is placed. If participants have issues, and they consent to help, the researcher will aid in positioning the chest strap.

7. Cleaning

Equipment should be cleaned following the department cleaning protocols

<https://wiki.bath.ac.uk/display/EO/Cleaning+in+the+labs>. In particular any parts which are frequently touched should be cleaned thoroughly.

Chest Strap – a cloth should be sprayed with 70% alcohol solution and then wiped on the device at the touch points.

Balloon Cover – these should be washed between participants

8. Data Management

9. Risks

The attached risk from must be reviewed by any user prior to using the equipment.

10. References

Electric Air Compressor – User Manual <https://product-downloads.freshclick.co.uk/download/file/bqsvlgtsd2/315/93>

BioPac MP 150/160 SOP - [file:///H:/dos/Downloads/Standard%20Operating%20Procedure_Biopac%20V2.0%20\(1\).pdf](file:///H:/dos/Downloads/Standard%20Operating%20Procedure_Biopac%20V2.0%20(1).pdf)

Cleaning in the labs: <https://wiki.bath.ac.uk/display/EO/Cleaning+in+the+labs>

11. Appendix A – Risk Form

In the table, please list all risks associated with your research related activity. You should detail the risk, who could be affected (researcher, participant etc.) and how you will mitigate it. Finally using the [guidance](#) please provide a risk score.

Overview of activity / location / equipment / conditions being assessed:

| Authors: Alexz Farrell, Dr Susanna Martin | | Overview: The activity involves individuals holding a pneumatic sphere which inflates and deflates in relation to a user's breath-based biofeedback. The system consists of a Laptop, an Air Compressor, a solenoid Circuit (to release air in and out of the system), the Biopac system, and an inflatable object. The user will always be seated and be holding the object during the operation. | | | | |
|--|---|--|--|---|---|-------|
| Associated with risk form: RA-50-2023A | | | | | | |
| # | Hazard(s) identified | Persons affected | Methods of mitigating risk | A | B | A x B |
| 1 | Electrical Accidental contact with live conductors. Electrocution by unsafe equipment. Fire. | Students, academic and technical staff, porters, estates | <ul style="list-style-type: none">Electrical equipment should be used for its designed purpose and checked before use. If equipment appears to be damaged or is not working properly then it should not be used and reported to the Research hub support team and the PI/supervisor.Keep water away from mains sockets.Ensure no electrical equipment is in front of the compressor valve before venting – Ensure the compressor itself is not moved while pressurised.Standard power sockets (no high V/A exposed devices) | 5 | 1 | 5 |
| 2 | Slips, trips and falls Tripping over cables, slipping on spilled liquids, falling over due to items being left on the floor. | Students, academic and technical staff, porters, estates | <ul style="list-style-type: none">Walkways are to be kept clear of obstructions. Good housekeeping to ensure area is tidy.Any spilled liquid (water, oil etc.) or other slip hazard is cleaned up immediately and thoroughly.There should be no loose electrical cables on the floor. Shortest cabling routes (not on the floor) should be used where possible. Where necessary, electrical cables to be routed in elevated positions by preference. If not possible, cable covers will be installed to protect both equipment and persons affected. | 3 | 2 | 6 |

| Authors: Alexz Farrell, Dr Susanna Martin Associated with risk form: RA-50-2023A | | Overview: The activity involves individuals holding a pneumatic sphere which inflates and deflates in relation to a user's breath-based biofeedback. The system consists of a Laptop, an Air Compressor, a solenoid Circuit (to release air in and out of the system), the Biopac system, and an inflatable object. The user will always be seated and be holding the object during the operation. | | | | |
|---|---|--|---|---|---|-------|
| # | Hazard(s) identified | Persons affected | Methods of mitigating risk | A | B | A x B |
| | | | <ul style="list-style-type: none"> All Equipment will adhere to SOP and ensure Pneumatic and Electrical Wires, be routed away from the user side of the display, preventing any risk of slips, trips or falls | | | |
| 3 | Experiments running unattended Malfunction of experiment while unattended. | Students, academic and technical staff, porters, estates | <ul style="list-style-type: none"> Equipment must be powered down when an organizer needs to leave the room. The equipment must not be left running and unattended. All testing equipment will be stored safely when not being used. The air in the compressor will be vented out at the end of the study with the participant, mitigating the risks of leaving the equipment unattended. As stated within the SOP, appropriate ventilation instructions will be given to ensure safe release of air for producing safe sound levels under 100 dB. | 3 | 1 | 3 |
| 4 | Inexperienced users Increased risk due to lack of awareness/ experience | User Study Participants | <ul style="list-style-type: none"> An Experienced user will always accompany a participant and operate the testing equipment. An Inexperienced user (i.e., new researcher) will always interact with the prototype after completing an introduction and training from the Experienced and SOP before using the equipment. New users will not be able to interact with any of the other testing equipment | 4 | 1 | 4 |
| 6 | Manual Handling Injuries due to lifting, pulling, pushing or carrying a load such as strains, sprains, crushed fingers/toes. | Study Organisers & Participants | <ul style="list-style-type: none"> Manual handling should be avoided wherever possible. Suitable, well maintained assistive equipment should be used, e.g. trolley, sack truck, fork lift truck, wheeled cages, etc. where items need to be moved. Frequently used items should be at an easily accessible height. Loads should be packed carefully to keep to a manageable size and prevent movement of the contents in the package. Keep the load as close to the body as possible. Avoid twisting - move feet instead. | 4 | 2 | 8 |

| Authors: Alexz Farrell, Dr Susanna Martin Associated with risk form: RA-50-2023A | | Overview: The activity involves individuals holding a pneumatic sphere which inflates and deflates in relation to a user's breath-based biofeedback. The system consists of a Laptop, an Air Compressor, a solenoid Circuit (to release air in and out of the system), the Biopac system, and an inflatable object. The user will always be seated and be holding the object during the operation. | | | | |
|---|--|--|---|---|---|-------|
| # | Hazard(s) identified | Persons affected | Methods of mitigating risk | A | B | A x B |
| | | | <ul style="list-style-type: none"> User Study Participants are not allowed to lift heavy objects. The Compressor will only be moved when depressurized and with the use of assistive equipment where necessary. | | | |
| 7 | Air Compressor unit | Study Organisers & Participants | <ul style="list-style-type: none"> Compressor must only be operated by trained users Compressor must not be over-pressurized (Safety valve will prevent this) Regulator must not be tampered with or set higher than 7 bar of pressure Gas tubing should not be tampered with while compressor is being used Compressor should not be stored while pressurized. Pressure must be released when not in use Compressed air must never be directed at people or sensitive equipment Compressor must not be left unattended while on to prevent overpressurization Compressor must remain on the anti-vibration matt next to the desk while in use Pneumatics Equipment will be Depressurized, Unplugged and stored safely outside of testing hours. | 4 | 2 | 8 |
| 8 | Bespoke Hardware Physical Artefact for Well-being Support | Study Organisers & Participants | <ul style="list-style-type: none"> The User study will involve the use of bespoke hardware in the form of a "Physical Artefact for Well-being Support". The object consists of two layer balloon (with cotton exterior) which are pneumatically pressurised to a low pressure (0 -> 15KPa). This pressure is similar to that of a party Balloon. When pressed the object feels soft or stiff, depending on the pressure. If the Device was over-pressurised, it could bulge, rip or tear causing air to leak out. Though this poses very low risk to the user due to the low pressure. | 2 | 3 | 6 |

| Authors: Alexz Farrell, Dr Susanna Martin Associated with risk form: RA-50-2023A | | Overview: The activity involves individuals holding a pneumatic sphere which inflates and deflates in relation to a user's breath-based biofeedback. The system consists of a Laptop, an Air Compressor, a solenoid Circuit (to release air in and out of the system), the Biopac system, and an inflatable object. The user will always be seated and be holding the object during the operation. | | | | |
|---|------------------------------|--|--|---|---|-------|
| # | Hazard(s) identified | Persons affected | Methods of mitigating risk | A | B | A x B |
| | | | <ul style="list-style-type: none"> The risk of over-pressurising has also been minimised through the use of off the shelf commercial pressure regulators, and the system design. In accordance with SOP a "System Test" should be completed every calendar day before use. An emergency pressure release button and pressure valve are located next to the researcher so pressure can be cut if required. | | | |
| 9 | Covid Close proximity | Study Organisers & Participants | <ul style="list-style-type: none"> The Organiser will be located in the adjacent room during the operation of the device. Cleaning and disinfecting in accordance with the department cleaning guidelines (https://wiki.bath.ac.uk/display/EO/Cleaning+in+the+labs) with additional guidance from the Uk Government: COVID-19: cleaning in non-healthcare settings outside the home. Frequently touched surfaces including device, doors, and chair are regularly cleaned. This will entail frequently washing the cotton exterior. Alcohol based hand sanitiser is provided | 2 | 3 | 6 |
| 10 | BioPac sensor placement | Participants | <ul style="list-style-type: none"> Participants will be required to place a chest band on themselves to record their breathing (this is then what influences the pressure in the balloon). To minimize contact, participants will place the chest band on themselves, they can do this while the researcher is in the adjacent room, meaning the participant can place the chest strap under clothing if required. Visual aids will be provided to show the participant how to apply the chest strap. The chest strap will be wiped with 70% alcohol solution between users to minimize health risks. | 2 | 1 | 2 |

| | |
|--|---|
| Hazard Severity (a) <i>the potential impact the risk would have if it were to occur</i> <ol style="list-style-type: none"> Trivial (eg discomfort, slight bruising, self-help recovery) Minor (eg small cut, abrasion, basic first aid need) Moderate (eg strain, sprain, incapacitation > 3 days) Serious (eg fracture, hospitalisation >24 hrs, incapacitation >4 weeks) Fatal (single or multiple) | Likelihood of Occurrence (b) <i>likelihood for the risk to occur after you have undertaken precautionary measures.</i> <ol style="list-style-type: none"> Remote (almost never) Unlikely (occurs rarely) Possible (could occur, but uncommon) Likely (recurrent but not frequent) Very likely (occurs frequently) |
|--|---|

| Rating Bands (a x b) | | |
|---|--|--|
| <i>Risk ratings of above 9 will require further review to establish the safety of the event/research.</i> | | |
| LOW RISK (1 - 8) | | Continue, but review periodically to ensure controls remain effective |
| MEDIUM RISK (9-12) | | Continue, but implement additional reasonably practicable controls where possible and monitor regularly |
| HIGH RISK (15 - 25) | | -STOP THE ACTIVITY- Identify new controls. Activity must not proceed until risks are reduced to a low or medium level |

| | Trivial | Minor | Moderate | Serious | Fatal |
|--------------------|---------|-------|----------|---------|-------|
| Remote | 1 | 2 | 3 | 4 | 5 |
| Unlikely | 2 | 4 | 6 | 8 | 10 |
| Possible | 3 | 6 | 9 | 12 | 15 |
| Likely | 4 | 8 | 12 | 16 | 20 |
| Very Likely | 5 | 10 | 15 | 20 | 25 |