Research SOP & ERP

Laboratory Room Number: 1B19.1
Principal Researcher: Travis Wiens (306) 966-1241
SOP & ERP Name: Pump Wear Testing Facility
SOP & ERP Creator: Doug Bitner (306) 966-5462/ Shaunti Bergen (306) 360-7035
Date of Latest Revision: October 22, 2018

(See Appendix for Instructions and Additional Information)

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GENERAL INFORMATION

Research Synopsis

This Standard Operating Procedure (SOP) provides general instructions to operate the Pump Wear Testing Facility. All general lab safety practices must be followed in addition to those cited in this SOP. This SOP applies to all parties using this equipment

Known Hazards

List Physical Hazards:

i. Slip hazard from oil spills or oil leaks on the floor.
ii. Cut hazard due to pressurized oil jets from leaking pipes or hoses.
iii. Burn hazard due to hot reservoirs, pipes, hoses, valves or pumps.
iv. Entanglement hazard due to rotating shafts.

List Chemical Hazards:

i. Toxic hazard if oil jet penetrates the skin.

Safety Data Sheets Location

Near front door of 1B19

Emergency Response Equipment Location

Equipment:	Location:
First Aid Kit	Near front door of 1B19
Fire Extinguisher	Near side door of 1B19 and near entrance of 1B19.1
Spill Kit	Near side door of 1B19 and inside door of 1B19.1
Emergency Gas Shutoff	N/A

Required Training

Formal: Lab Safety Course, Lab Orientation, WHMIS

Lab-specific: using this SOP and ERP, Fluid Power Laboratory Safety Procedure Certificate

Required Personal Protective Equipment

Standard laboratory attire (long pants and closed-toe shoes, hair back, no jewelry)

Eye protection: Safety Glasses

Gloves: For adjusting manual valves or collecting samples of fluid (which may have become hot during operation)

Other: Hearing protection required when all pumps are operating

STANDARD OPERATING PROCEDURE

Description of Required Equipment

Lab equipment: Relays and emergency switch to shut off the electric motors (driving the pumps) in the event of an emergency shutdown situation.

Procedural Steps

1) **Set Up:**
   i. Ensure that all hydraulic lines are properly connected and unused ports are capped, plugged or closed. This includes the back of the reservoir.
   ii. Ensure all drive shaft shields are in place.
   iii. Ensure level of fluid in the reservoir is adequate (2 inches above inlet port) and the remaining portion of the reservoir has been coated in fluid to prevent rust.
   iv. Ensure the pump case drain has been filled prior to initial startup. This can be done through the top case drain port. Depending on orientation, this could be case drain ports D1, D2 or D3. Ensure the port plug is replaced.

2) **Start Up Procedure for Each Pump:**
   i. Enable the **Emergency Stop for 4 Pump System** button.
   ii. Turn on all relay boxes.
   iii. Open the required Simulink algorithm and make sure the correct shut down ranges are in place for case drain temperature, shaft speed and speed, outlet flow and inlet, case drain, outlet pressure. The proper temperature for heat exchanger activation should also be set.
   iv. Open the ball valve to the pump inlet and return to tank.
   v. Start the electric motor by pushing the green button on the appropriate breaker box on the north wall.
   vi. The pump should run smoothly after the first two minutes of operation. If it doesn't, turn off the pump motor (red button on the breaker box) and troubleshoot the problem.
   vii. Start the Simulink algorithm (AllSensors_4pumps) and then plug in the Arduino. Cyclic loading should begin. If not, troubleshoot the problem.
   viii. Ensure that there are no fluid leaks.
   ix. Monitor the experiment throughout testing with visual checks (approximately every half hour).

3) **Shut Down Procedure for Each Pump (Non-Emergency):**
   i. Stop the Simulink model.
   ii. Wait until the ardunio shuts down the pumps due to no response from computer.
   iii. If Arduino does not shut down the pumps press the red button on the breaker box of the north wall to stop the pump.
   iv. Close the ball valve to the inlet of the pump.
   v. Ensure all pressure is removed from the lines if the circuit is to be disassembled.

EMERGENCY RESPONSE PROCEDURE

Procedural Steps

1) **Pump Failure:**
    i. Because of the nature of the experiment of running pumps to failure, a failed pump is expected to occur. Safety protocols have been installed in the system to shut down the pump when this occurs. If the pump motor doesn't stop as required, Press the **Emergency Stop for 4 Pump System** button.

2) **Hose Failure:**
    i. If a hydraulic hose fails, there may be hydraulic fluid spray in the room. Press the **Emergency Stop for 4 Pump System** button and follow procedure for Fluid Leak (below).

3) **Fluid Leak**
    i. If there is a leak and hydraulic fluid is spilled on the floor, Press the **Emergency Stop for 4 Pump System** button, have the leak repaired and clean up the spill using the spill kit provided in Rm. 1B19. Note: Fluid and hydraulic circuits may be hot. Proceed with caution.

4) **Hydraulic Fluid Contacts the Skin**
    i. If hydraulic fluid contacts the skin, clean it off as soon as possible. Note: the fluids used in these experiments are non-toxic, (see fluid SDS in 1B19 for further information).

5) **Hydraulic Fluid Penetrates the Skin**
    i. If hydraulic fluid penetrates the skin, SEEK MEDICAL ATTENTION IMMEDIATELY.

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Local Responsibilities and Contact Information

NAME	TITLE & DEPARTMENT	WORK (OFFICE) PHONE	HOME (CELLULAR) PHONE	PRIME DUTIES & TASKS
Shaunti Bergen	M.Sc. Grad. Student Mech. Eng. Dept.	(306) 966-5463	(306) 360-7035	• Develop and use Lab/research-specific ERP and experimental set-up shutdown procedures • See responsibility list
Doug Bitner	Departmental Assistant Mech. Eng. Dept.	(306) 966-5462	(306) 290-3189	• Develop and use Lab/research-specific ERP and experimental set-up shutdown procedures • See responsibility list
Travis Wiens	Prof. Mech. Eng. Dept.	(306) 966-1241		• Review and approve Lab/research-specific ERP and experimental set-up shutdown procedures • See responsibility list
	Safety Resources	306-966-**4675**	306-966-**5555** (afterhours)	• Provide advice
Facilities Management Division	Customer Service Centre (FMD)	306-966-**4496**	306-966-**5555** (afterhours)	• Verify ventilation system operation Verify emergency power operation
Local Emergency Dispatch	Protective Services	306-966-**5555** (call 24/7)	• Initiate and support emergency response Establish perimeter	
Municipal Emergency Responders	• Ambulance • Fire • Police	**911 from mobile or 9-911 from U of S landline**	Emergency responders	
Andrea Book	Chief Building Warden (CoE)	306-966-**5388**	See Building ERP for cellular	• Help coordinate building evacuation

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APPROVAL & ACKNOWLEDGEMENTS

Principal Investigator (Supervisor) Approval of this SOP and ERP

Name	Title	Signature	Date

Researchers & Students who have Reviewed, Understand & Use this SOP and ERP

Name	Supervisor	Signature	Date

TROUBLE SHOOTING

Problem:	Solution:
Electric motor does not start	Ensure breaker box lever is in the correct position. Check if Emergency Stop Button is enabled
Cyclic valves do not work	Check if the correct configurations and valve addresses are used. Ensure the valve cables are properly plugged in.
Pressure Transducers do not work	Check the name, address and cable connection. The name should be listed on the pressure transducer itself.
Safety and Heat Exchanger relays do not trigger correctly	Ensure the outputs required are checked within the configuration for the DAQ
Reservoir is full of air bubbles	Inlet opening may be restricted due to debris build up and may need to be unobstructed.

APPENDIX

Instructions

1) Complete all **yellow highlighted** areas in all sections, and delete if not applicable.
2) Use Resources below for assistance.
3) Area Supervisor (PI) must review and sign to approve this SOP & ERP prior to commencing related work.

Resources

- For assistance please talk to your supervisor, or email Safety Management System Specialist
- Link to Access to Building Emergency Response Plan and other college safety/security resources: http://engineering.usask.ca/service-and-support/safety-security.php
- Link to University Safety Resources: http://safetyresources.usask.ca/

ERP Responsibilities

The following responsibilities are delineated to ensure that emergency situations arising from work performed in any laboratory are minimized and responded to properly:

Supervisor or Principal Investigator

- Ensure the development, maintenance and periodic revision of Standard Operating Procedures for safety systems and laboratory operations
- Ensure the development, maintenance and periodic revision of the Emergency Response Plan
- Ensure inspection and maintenance of laboratory equipment containing hazardous substances, or that otherwise pose a hazard to health or safety
- Ensure the provision of PPEs for all employees as necessary
- Ensure access to MSDSs for all hazardous substances in the laboratory
- Ensure the provision of training for all laboratory occupants and users with regard to:
    - SOPs
    - The ERP
    - SDSs
    - PPE use and maintenance
    - Safety systems parameters and operation
    - Equipment use and maintenance
- Ensure that documentation and log books are kept for all training, safety systems monitoring, equipment inspection and calibrations
- Personally inspect training records and logs periodically to ensure compliance with SOPs

Researchers and Laboratory Occupants

- Read, ensure understanding of, and follow all laboratory SOPs specific to your work and general laboratory safety
- Read and ensure understanding of the ERP
- Read SDSs for all hazardous substances in the laboratory prior to use of the substances
- Inspect and ensure adequacy of PPE and use them as required
- Attend all prescribed safety training
- Keep accurate records per prescribed frequencies in the laboratory SOPs

- Perform duties in a safe manner to protect the life and health of yourself, your coworkers and other occupants of the laboratory and the Engineering building

Chief Building Warden

- Ensure evacuation of the building if the situation dictates
- Liaise with laboratory, facility, University and emergency response personnel, ensuring that pertinent information is passed