NIOSH
National Institute of Occupational Safety and Health

OSHECT JOURNEY TO NIOSH LABORATORY EXCELLENCE

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OSHECT JOURNEY TO NIOSH LABORATORY EXCELLENCE

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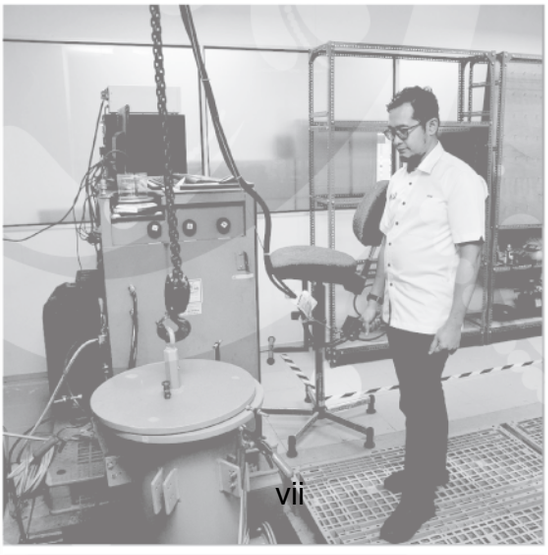

FOREWORD

As Chairman of the National Institute of Occupational Safety and Health (NIOSH), I would like to congratulate NIOSH for the publication of **"OSHECT Journey to NIOSH Laboratory Excellence"**, a compilation of articles authored by experts from technical experts and technical officer NIOSH. This publication will serve as a platform for any interested parties. NIOSH has aspired to ensure that information, messages, and technical knowledge related to OSH are communicated to the grass root level.

For your information, OSH Hazard Evaluation and Control Technology Centre (OSHECT) is a part of government's aspiration to help NIOSH achieve its vision and mission as the centre of excellence in occupational safety and health in Malaysia. It is an additional facility development project on NIOSH campus to diversify new activities including training, consultation, research, and development and information dissemination. The components of this project consist of the development of several high technology laboratories. Among the major laboratories are personal protective equipment testing, chemical analysis, engineering forensic, scientific equipment calibration and workplace hazard simulation laboratories.

I am confident that the publication will prove beneficial to local and international OSH practitioners and interested parties as it covers a whole range of topics from various laboratories and disciplines.

Finally, I would like to congratulate NIOSH for the efforts and initiative taken to publish this book. I believe this book will be a useful source of reference and information for those who are directly or indirectly involved in the administration and management of occupational safety and health.

YB DATUK WILSON UGOK ANAK KUMBONG
Chairman
NIOSH

PREFACE

The publication of "**OSHECT Journey to NIOSH Laboratory Excellence**" intends to address the need for more OSH-related information as well as to provide an overview of facility development project on NIOSH. The establishment of this OSH Hazard Evaluation and Control Technology Centre (OSHECT) is very significant to support the existing legal structure. The centre provides a complete source of reference to the industry and assist them effectively towards OSH-related legislation. This centre can make NIOSH a leading research and commercialization centre in the field of OSH, especially for researchers, makers, designers, marketers and sellers. The establishment of OSHECT is also to ensure that NIOSH is always as dynamic and competitive as other research institutions. In addition, it will also improve the quality of NIOSH services in line with NIOSH's mission and vision to become a leader in the field of OSH.

Hence, information shared can be used as a reference or for benchmarking to enhance OSH in Malaysia in the future. Apart from that, this book is also useful for those who are involved in safety and health in the workplace or who need to have a better understanding of OSH in Malaysia.

We hope this publication will encourage more knowledge and experience-sharing opportunities among OSH practitioners and others which is important to enhance the database of OSH-related information.

HAJI AYOP SALLEH
Executive Director
NIOSH

ACKNOWLEDGEMENTS

Thanks to the Almighty for His blessings and grace that the publication of "**OSHECT Journey to NIOSH Laboratory Excellence**" is completed. We are extremely grateful to the contributors for their effort in preparing the manuscripts. This book would not exist without their contributions.

Under the Eleventh Malaysia Plan (11th MP) the Government of Malaysia, through the Ministry of Human Resources, has allocated RM25 million fund to develop an integrated OSH laboratory known as OSH Hazard Evaluation Control Technology Centre (OSHECT) to realise the vision and mission on the establishment of NIOSH as the centre of excellence in occupational safety and health in Malaysia. NIOSH developed the project from the year 2016 to 2022. The project's main objective is to provide support facilities for activities at NIOSH Headquarters in Bandar Baru Bangi, Selangor and Southern Regional Office, Johor. Other objectives of OSHECT are:

- To provide the capability and capacity of OSH technical service, the quality of delivery, and its effectiveness.
- To provide OSH scientific evidence through upgraded and modernized testing facilities.
- To enhance OSH research development through technical sharing.
- To preserve and strengthen the relationship between government and industry in terms of OSH.

The development of OSHECT involves the construction of high-technology laboratories. Some of the laboratories have been accredited; the rest are in the process of accreditation by the Department of Standards Malaysia (DSM). The thirteen (13) laboratories are:

1. Chemical Hazardous to Health Laboratory (CHL)
2. Gas Detector Calibration Laboratory (GCL)
3. Dust Mask Laboratory (DML)

4. Fall Protection Equipment Testing Laboratory (FPETL)
5. Human Ergonomics Assessment Laboratory (HEAL)
6. Environmental Ergonomics Laboratory (EEL)
7. Forensic Engineering Laboratory (FEL)
8. Scientific Equipment Calibration Laboratory (SECL)
9. Hydrostatic and Refilling Laboratory (HRL)
10. PPE Simulation Laboratory (PSL)
11. Occupational Health Laboratory (OHL)
12. Face and Medical Mask Laboratory (FMML)
13. Gas Mask Laboratory (GML)

Finally, we like to express our deepest appreciation to the Executive Director of NIOSH, Haji Ayop Salleh, General Manager of Consultation, Research and Development Department (CRD), Haji Khairunnizam Mustapa who are very helpful in ensuring the smooth running of the activities and programs conducted throughout the publication period.

Special thanks to the publication team, comprising Mr. Mohd Nur Ikhwan Shafiee, Ms. Syaza Hani Jamaludin, Ms. Joy Khong Chooi Yee for their cooperative, constructive views and comments in completing this book. Not forgetting NIOSH staff from other departments for their help in ensuring the smooth running of the completion of this book.

Fadzil Osman
Mohd Esa Baruji
Shahronizam Noordin
Editors' team

ABBREVIATIONS

ASTM/ NIOSH	American Society for Testing and Materials/ National Institute for Occupational Safety and Health
CHL	Chemical Hazardous to Health Laboratory
CRDD	Consultation, Research and Development Department
DML	Dust Mask Laboratory
EN	European Standard
EEL	Environmental Ergonomics Laboratory
FEL	Forensics Engineering Laboratory
FMML	Face and Medical Masks Laboratory
FPETL	Fall Protection Equipment Testing Laboratory
GCL	Gas Detector Calibration Laboratory
GML	Gas Mask Laboratory
HEAL	Human Ergonomics Assessment Laboratory
HRL	Hydrostatic and Refilling Laboratory
ISO	International Organisation for Standardisation
LA	Laboratory Advisor
MS	Malaysian Standards
OHL	Occupational Health Laboratory
OSH	Occupational Safety and Health
OSHECT	OSH Hazard Evaluation and Control Technology Centre
PPE	Personal Protective Equipment
PSL	PPE Simulation Laboratory
RPE	Respiratory Protective Equipment
SECL	Scientific Equipment Calibration Laboratory
TO	Technical Officer
YY/GB	China Standard

FALL PROTECTION EQUIPMENT TESTING LABORATORY (FPETL)

1

FALL PROTECTION EQUIPMENT TESTING LABORATORY (FPETL)

Ts. Mohd Esa bin Baruji, Muhammad Hairul Farique bin Mohd Fuadi, Mohd Fadzli bin Ismail

1.1 INTRODUCTION TO FALL PROTECTION EQUIPMENT TESTING LABORATORY (FPETL)

Initially, the idea of establishing a Fall Protection Equipment Testing Laboratory (FPETL) started from a courtesy visit from the National Institute of Occupational Safety and Health (NIOSH) Malaysia to the Korea of Occupational Safety and Health Agency (KOSHA), Republic of Korea. NIOSH Malaysia was given the responsibility to develop a test laboratory under the Eleventh Malaysia Plan (11^{th} MP) to be used by workers in Malaysia to test and provide fall protection equipment used under relevant standards such as the BS EN standard and MS standard. Therefore, the construction of the FPETL began in June 2017 and was officially completed in August 2018. There are three main goals for establishing FPETL:

1. To provide services such as testing and certification for fall protection equipment and component used by industries;

2. To ensure and endorse all fall protection equipment and component use comply with Malaysia Standards (MS) as well as other international technical standards such as European Standard recommended by the manufacturer; and

3. Provide service and facility for research and development (R&D) related to fall protection equipment.

Figure 1.0 Official visit from Deputy Minister of Human Resources to FPETL, accompanied by NIOSH Vice Chairman and NIOSH Executive Director

1.2 WHAT DOES FPETL DO?

FPETL was fully equipped with three main facilities such as i) static strength testing room, ii) climatic testing room, and iii) dynamic performance testing tower.

FPETL conducted research entitled "Study of compliance of fall protection equipment with the MS standard". One of the findings shows that only 60% of common brands available in the Malaysian market are MS compliant. What about the remaining 40%? In addition, according to the results obtained, there were 18% full body harnesses, 50% lanyards, 7% connectors and 20% energy absorbers unsuitable for use (NIOSH, 2017). This is a major concern for the reliability and integrity of the equipment when in use because the safety of working at height is highly dependent on the performance of the equipment. It is recommended that NIOSH, through its FPETL collaborate with the Malaysia Department of Safety and Health (DOSH) as the enforcer, the Standard and Industrial Research Institute of Malaysia (SIRIM) as the Certification Body, and supplier/ manufacturer to ensure that every personal protective equipment against fall from height supplied to the Malaysia market are verified accordingly.

Currently, our testing facilities meet the related Malaysian standard and International standard requirements such as the BS EN standard. The following standards are:

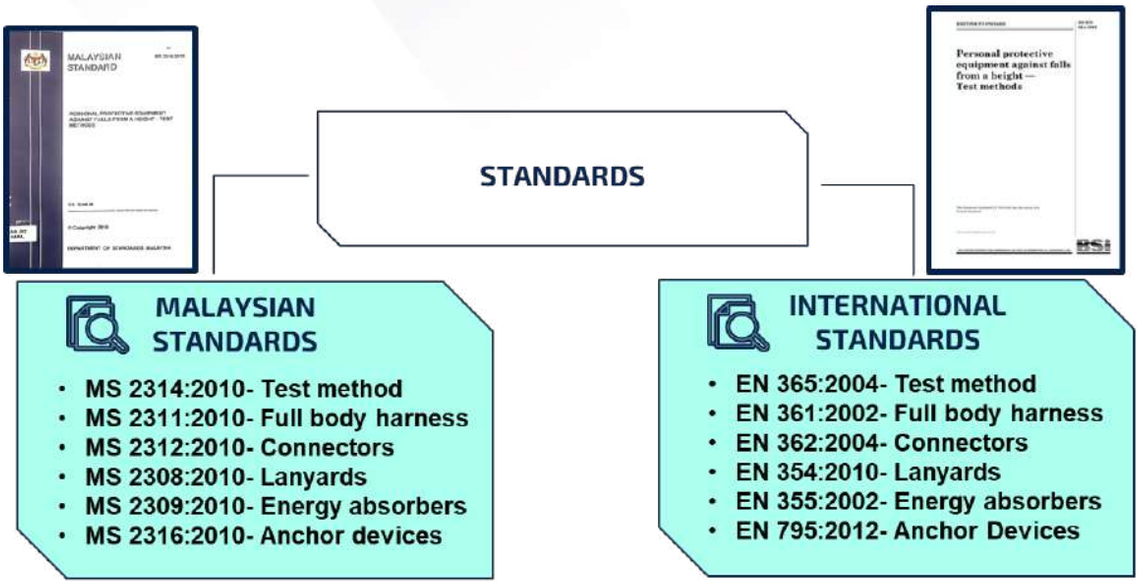

Figure 1.1 Static strength room, dynamic performance tower, and conditioning room

Since then, FPETL has received a request from more than 10 companies/ total projects such as JF Building Tech Sdn Bhd, PDS Safety Sdn Bhd, Top Slings Trading Sdn Bhd, MSA Safety Malaysia Sdn Bhd, HVT Engineering Sdn Bhd, Yeowchuan Hardware Sdn Bhd, 3M Malaysia Sdn Bhd, Further Advance Industries Sdn Bhd, Safetyware Sdn Bhd and Firatel Sdn Bhd.

Examples of fall protection equipment brands sent to FPETL for testing are A-stabil, Worksafe, Workgard, BST, HT, Dbi-Sala, MSA, FA, Safetyware and Ptetgrd.

1.3 IS TECHNICAL TRAINING PROVIDED?

To ensure the credibility and competency of a team, five NIOSH Malaysia personnel was sent for training conducted from 25 to 27 September 2017 in collaboration with KOSHA, the Republic of Korea at their testing facilities in Ulsan, Republic of Korea. For the continuation of FPETL building capacity, one from NIOSH Malaysia and NIOSH Certification Sdn Bhd respectively attended the fellowship training specifically safety certification system of Korea from 22 to 25 October 2019.

In 2019 also, to enhance the quality of the laboratory management system, a few series of training programmes had been conducted such as:

1) Understanding Implementing of ISO/IEC 17025:2017,
2) General Requirement for the Competency Testing and Calibration Laboratories,
3) Calibration of Force Measurement Device,
4) Measurement Uncertainty Evaluation of Force Calibration, and
5) Method Validation and Verification.

In addition, to ensure the skills of the laboratory personnel of FPETL improve, one inspection course for Personal Protective Equipment (PPE) has been conducted from 7 to 9 June 2022. The course was attended by Laboratory Advisor, Ts. Haji Mohd Esa bin Haji Baruji, FPETL Technical Officer Mr. Muhammad Hairul Farique bin Mohd Fuadi and FPETL Senior Technician Mr. Mohd Fadzli bin Ismail. The trio successfully passed the assessment conducted during training and qualified as a competent person as PPE Verifier and Inspector for protection against falls from height.

Figure 1.2 FPETL personnel attended the PPE inspection and verification course (Picture: During assessment session)

1.4 WHAT IS FPETL ACTIVITY?

Besides conducting testing, FPETL is also involved in various other activities of the institute to educate and disseminate the related fall protection equipment technical information as shown below.

Figure 1.3 1) Static strength test for connector, 2) Static strength test for full body harness, 3) Dynamic performance test for the full body harness

FPETL is also designing many infographic materials for the public in enhancing the awareness and understanding of the industry regarding basic fall protection equipment and the importance of testing to the real-life occupations. Below are a few examples of the infographic available on the NIOSH website.

Figure 1.4 Infographics

FALL PROTECTION EQUIPMENT TESTING LABORATORY (FPETL)

HYGIENIC CARE TIPS FOR FULL BODY HARNESS DURING COVID-19 PANDEMIC

FULL BODY HARNESS is a body support device primarily for fall arrest purposes, i.e. a component of a fall arrest system. The full body harness may comprise straps, fittings, buckles or other elements, suitably arranged and assembled to support the whole body of a parson and to restrain the wearer during a fall and after the arrest of a fall.

DO'S

- ✓ Cleaning techniques of any piece of full body harness can be found in the product instructions.
- ✓ Remove all contaminants or build-up (dirt, paints, etc.).
- ✓ Soft surface (harness, lanyards) : Clean with warm water (less than 40 degree c) and mild soap solution.
- ✓ Hard surface (connectors, d-rings, buckles) : Generally sanitize the equipment with soap, water and a rag.
- ✓ Fully dry in a well-ventilated area.
- ✓ Wash up yourself before and after finish the cleaning.

DON'TS

- ✗ Do not machine dry under any circumstances.
- ✗ Never use aggressive cleaning agents such as naphtha, turpentine, acetone or other similar products.
- ✗ Never use sanitizer on soft surfaces of harness.
- ✗ Do not share full body harness with others.

PREVENT THE SPREAD OF COVID-19 IN 7 STEPS

- Wash your hands frequently or use hand sanitizer.
- Avoid handshakes.
- Cover your mouth when coughing / sneeze.
- Wear face mask during working.
- Immediately seek medical care if sick.
- Distancing yourself from others (at least 1 meter).
- Do not share PPEs with others.

#StopTheSpread

" MAKE CLEANING YOUR EQUIPMENT AS A HABIT "

BETTER SAFE THAN SORRY!!!

STORAGE TIPS

1. Store your full body harness in a well-ventilated area
2. Reserve a specific place for your full body harness
3. Out of direct sunlight (UV).
4. Full body harness should not be stored in wet condition.
5. Neutral environment away from excessive heat or heat sources, high humidity, sharp edges

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Whatsapp : 013-2225155
Tel: 03-87692100 (Ext.: 9393)

In reference to :

bsi. CDC World Health Organization

FPETL is also involved in information dissemination activities such as Free OSH Talk organised by Information Dissemination Division (IDD), NIOSH and social media channel organized by Information Technology Division, NIOSH to the industry such as below:

Figure 1.5 NIOSH FB Live - "Working at Height: How to comply with the regulation"

Figure 1.6 NIOSH FB Live - "Introducing NIOSH Fall Protection Equipment Testing Laboratory"

Figure 1.7 NIOSH YouTube – Introduction of Fall Protection Equipment Testing Laboratory, FPETL.

Figure 1.8 OSHECT YouTube – Fall Protection Equipment Testing Laboratory

The laboratory also opens for public visits including from the industry, academic, and education sectors. The laboratory is also used for hands-on and demonstration activities in the training conducted by a few training and seminar activities such as:

1) Working safely at height;
2) Confined space trainer;
3) Authorised Gas Tester and Entry Supervisor for confined space;
4) Confined space rescue;
5) OSH Coordinator;
6) Safety and Health Officer;
7) Site Safety Supervisor;
8) Construction Safety and Health Trainer;
9) OSH seminar; and
10) OSH conference/ exhibition.

Figure 1.9 Visit from a confined space course participant

Figure 1.10 FPETL Involvement during Malaysian Family Aspirations 100-day Exhibition

Figure 1.11 Visitors from higher education institutes listening to the explanation from FPETL Approved Signatory Personnel.

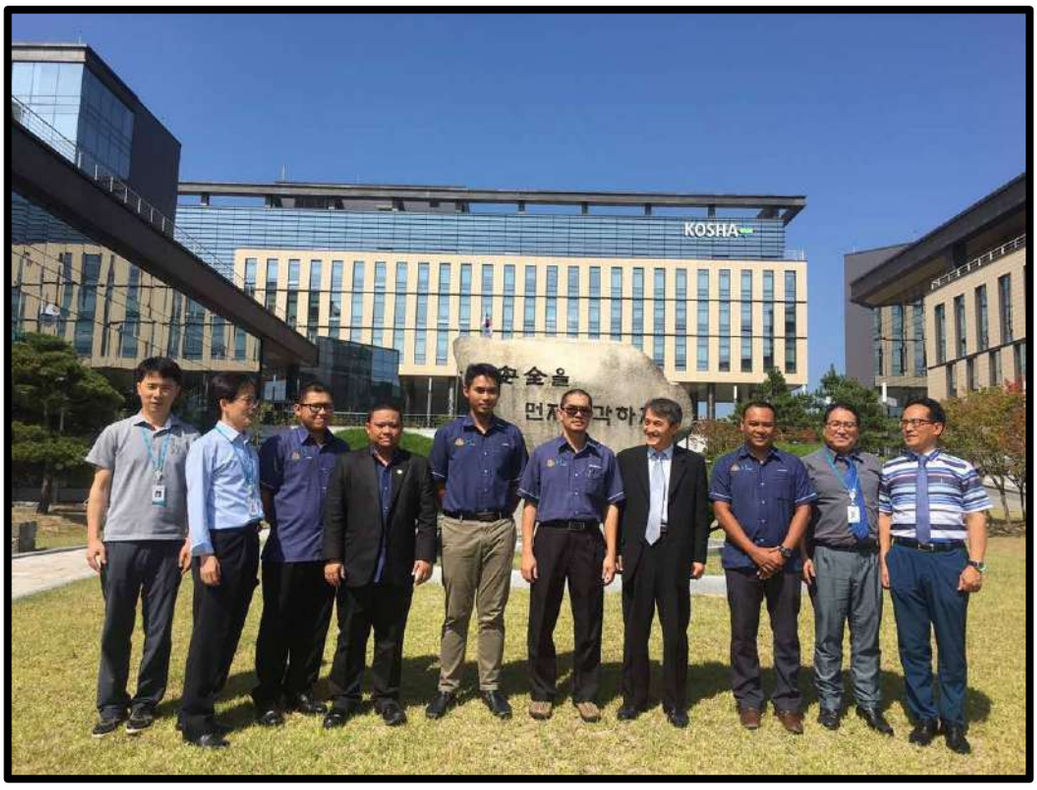
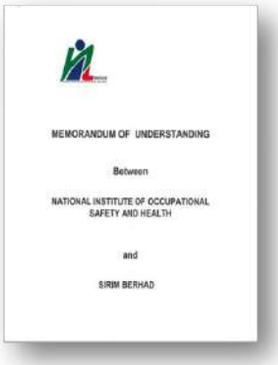


Figure 1.12 Official visit FPETL, NIOSH to Korea Occupational Safety and Health Agency (KOSHA) – Representatives from NIOSH: Ahmad Syauqi, Mohamad Redzuan, Tengku Hizir, Hj Shahronizam and Mohd Fadzli



MEMORANDUM OF UNDERSTANDING

Between

NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH

and

SIRIM BERHAD

Figure 1.13 Official visit from YB Datuk Rosni Sohar, Board of Director PTPTN

Figure 1.14 Official visit from National Metrology Institute of Malaysia (NMIM)

Figure 1.15 Official visit from Honeywell (M) Sdn Bhd

Figure 1.16 Official visit FPETL, NIOSH to Petzl (M) Sdn Bhd

1.5 ANY ACHIEVEMENT AND COLLABORATION? WAY FORWARD?

Currently, there are various types of fall protection equipment offered in Malaysia's market which is not being comprehensively controlled and monitored beforehand by the user. This also has led to various perceptions among the users, especially on the marking and certification, quality and safety & health features of the fall protection equipment offered by different companies. Thus, FPETL strengthen the capability by collaborating with SIRIM QAS International in terms of the certification process for DOSH-SIRIM PPE approval in Malaysia. This is to enhance safety labeling for the Personal Protective Equipment (PPE) especially for fall protection equipment that has been used by the worker in Malaysia. At the same time, FPETL as one of the laboratories under OSHECT aims to be a leading laboratory in fall protection equipment testing in this region with a 'Safety Mark'.

During the Conference of Occupational Safety and Health (COSH) 2019, international technical cooperation has been signed between the National Institute of Occupational Safety & Health (NIOSH) Malaysia and the Korea Occupational Safety and Health Agency (KOSHA), Republic of Korea. NIOSH was represented by Haji Ayob Bin Salleh, Executive Director of NIOSH while KOSHA was represented by Dr. Park Doo Yong, President of KOSHA. On 26th February 2020, NIOSH Malaysia with SIRIM Berhad signed one Memorandum of Understanding (MoU). The MoU will benefit both parties, especially in the technical information, technology and training field.

As the need of the market as a testing laboratory, it is a very huge achievement to be the accredited laboratory registered under The Department of Standard Malaysia. Therefore, FPETL has been gone through the process and completely certified as an accredited testing laboratory for ISO/IEC 17025:2017 in December 2021. FPETL is one of the pioneers of the fall protection equipment testing laboratory in Malaysia. Few Asian countries such as Sri Lanka, Pakistan, and Cambodia also make reference to our laboratory for technical collaboration on fall protection equipment via face-to-face, WhatsApp and email communication.

For future strategic framework, FPETL also plans to be:

1) Centre for PPE related to fall protection equipment inspection and verification. The institute will assist, advise and produce a comprehensive technical report and Certificate of Fitness for the organisation to decide on the further arrangement and future plans;

2) Enhance facilities to enable to test of the complete set of fall protection equipment such as seating full body harness, retractable fall arrestor and work positioning lanyard;

3) Upgrade facilities for research and development purposes such as installing the slow motion camera, salt spray test and corrosion test as well as research officer/ assistant attachment to the laboratory;

4) Listed as one of the international proficiency testing providers for fall protection equipment; and

5) Empowering the capability of the laboratory by collaborating with national and international certification bodies such as SIRIM and BSI, and planning to be one of the appointed hubs for mechanical testing.

1.6 BIBLIOGRAPHY OF TEAM MEMBERS

FPETL Laboratory Advisor (LA)

Ts. Hj. Mohd. Esa bin Hj. Baruji is currently as Principal Consultant/ Principal Researcher at CRDD, NIOSH Malaysia since 2018. In 1997, he was awarded the Bachelor of Engineering in Electronics from the University of Manchester Institute Science & Technology (UMIST), Manchester, United Kingdom. He pursued his Master in Industrial Safety Management from the National University of Malaysia on 2003. He is registered:

Industrial Researcher in MyGRANTS, Ministry of Higher Education (Registration No.: 88067);

1) Assessment Panel for OSH Program – Malaysia Qualifications Agency (MQA) (APP MQA No.: 2252);
2) Ex-Officio of NIOSH to Malaysian Society for Occupational Safety and Health (MSOSH) (Membership No.: 1184);
3) Professional Technologist in Manufacturing and Industrial Technology (ME) field (Certificate No.: PT20110256); and
4) Professional Technologist in Manufacturing and Industrial Technology (ME) field (Certificate No.: PT20110256).

With nearly 25 years of working experience in industry and institute, his patience with OSH is endless and makes him inspired to become an expert in the OSH field. In the consultation area, he specialized in:

1) OSH legislation compliance (e.g. process safety management, confined space risk assessment),
2) OSH solution (e.g. development of HIRARC, risk management, safety inspection, audit, OSH management system),
3) OSH advisory (e.g. customized/ in-house training development such as Electrical Safety, Lock Out Tag Out Test Out [LOTOTO], Permit To Work [PTW], OSH Induction), and
4) Laboratory service (e.g. advisor, laboratory management representative, approved signatory, equipment calibration, testing and industrial hygiene analytical process).

He was also involved in more than 11 OSH research projects as head project and researcher amounted value of up to more than RM7 million. He already presented and published his research findings as well as written books at the national and international seminar/ conference levels.

In contributions to the nation as a central committee in OSHMP2025, NCOSH, HRD Corp, NSC W, OSH Lead auditor/ panel, trainer, assessor, examiner, approved signatory, guideline & laboratory advisor, journal editorial board & review panel, expert review, panel judge, prominent writer & author, lecturer, competent person (confined space & scaffold), he was also involved in technical committee, working group and ex-officio in formulating the Malaysian Standards, Industry Code of Practices and Guidelines and National Occupational Skills Standard (NOSS) with :

1) National Council of OSH (NCOSH), DOSH, Department of Skills Development (DSD), Ministry of Human Resources,

2) SIRIM, Department of Standards Malaysia (DSM), Ministry of International Trade and Industry,

3) CIDB, Ministry of Works, and

4) MSOSH.

He had experience attending and consulting on OSH competency and leadership programmes in a few countries eg Japan, Germany, Saudi Arabia, Singapore, Cambodia, India and Taiwan (The Republic of China). He had presented more than 14 professional presentations at national/ international level and published more than 29 technical paper/ books. He obtained about 6 Award/ Copyright such as Gold Award: 32nd International Invention, Innovation & Technology Exhibition (ITEX) – Web Based School's Sports Safety Audit Tool (3SAT) CAI Model (2021), Copyright: NIOSH Anthropometric Data for Malaysian Working-Age Population (No.: CRLY2021W00339/ Category: Literature/ Application Date: 18 February 2021), Participation: Malaysian Anthropometric Measurement Tools and Portal, Ergonomics Product Design Competition (ErgoLympic) 2021, 1st Best Oral Presenter: International Sci-COSH, Johor Bahru, Malaysia with paper entitled 'Comprehensive Occupational Safety and Health Action Plan for SMEs Utility Industry' (2016), Gold award: Development of Lubricant Oil Quality Sensor for Transportation, Research & Innovation Expo, UKM (2014), and Dean Award: Master of Industrial Safety Management (2002/2003).

Technical Officer (TO)

Muhammad Hairul Farique bin Mohd Fuadi is a Bachelor of Mechanical Engineering holder. Currently in NIOSH as an OSH Solution Executive and Technical Officer of Fall Protection Equipment Testing Laboratory (FPETL) in Consultation, Research & Development Department (CRDD), NIOSH. He is also a SAMM Approved signatory for FPETL. Has been gone through the Safety Audit for fall protection equipment and high rope elements used by camps in Malaysia under Ministry of Youth and Sports, Malaysia. He also involved in RM2.6 million research & development project as research assistant and managed to produce OSH intervention prototype (in process of pattern registration). His strong technical knowledge in the engineering field to enhance safety, especially on testing parts all over the organization has contributed to the success of the lab.

Senior Technician (ST)

Mohd Fadzli bin Ismail is one of the SAMM Approved Signatory for the Fall Protection Equipment Testing Laboratory (FPETL). Also as a trainer for the Working at Height (WAH), Authorised Entry & Standby Person (AESP), Authorised Gas Tester and Entry Supervisor for Confined Space (AGTES), OSH Coordinator and varies of Safety Passport Course in NIOSH as well as auditor, inspector, assessor and researcher for varies of OSH program. Trained from KOSHA, Republic of Korea, has served NIOSH since 2010 and is involved as a committee member for the WAH module development. He is committed to helping the industry to ensure all the safety aspects, especially for employees working at heights are in safe working conditions.

DUST MASK LABORATORY
(DML)

2

DUST MASK LABORATORY (DML)

Baderin Osman, Haalah Mahmud

2.1 INTRODUCTION TO DUST MASK LABORATORY (DML)

It all started with...

It has always been a dream of the Consultation, Research and Development Department (CRDD), NIOSH to have laboratories for Personal Protective Equipment (PPE). As PPEs are also essential parts of safety and health, the establishment of PPE laboratories not only can provide facilities for research and development (R&D) but also can bring the institution itself to national and international levels.

In 2009, CRDD proposed to establish a laboratory for PPE, including a laboratory for dust (particulate) masks. The objectives of this laboratory are:

i. To perform laboratory tests on respirators as required under Malaysian Standards, that is also equivalent to European Standards.
ii. To provide facilities for R&D.
iii. To give support in the development and reviewing of Malaysian Standards related to respirators.
iv. To act as the third party for laboratory testing and as an independent body nationally and internationally.

The efforts finally paid off after the proposal was approved in 2016, through the budget of RMK-11. Without any further delay, the construction started to begin in July 2017. The construction took less than a year to complete.

The equipment slowly arrived from the United Kingdom (UK) in March 2018, then proceeded with commissioning and training, conducted by the senior engineer of INSPEC International LTD, UK.

Finally, the laboratory started its operation in 2019. To be the first RPE laboratory in ASEAN, DML hopes to serve its services nationally and internationally. To achieve that, it is important to obtain accreditation for measurement accuracy. DML received ISO 17025:2017

accreditation in 2021 and continuously strives to make a contribution to the government and community.

LET'S GET TO KNOW THEM…

Laboratory Advisor (LA)

Baderin bin Osman is also the **Technical Expert III** of CRDD, NIOSH and approved signatory under Skim Akreditasi Makmal Malaysia (SAMM). LA assumed the responsibilities and took charge of the operations at the Respiratory Protective Equipment (RPE) Laboratory. He gained some valuable experience through these new responsibilities. Since assuming this new appointment, he is actively involved in events related to RPE, such as conducting laboratory testing, delivering talks on RPE and publishing research papers. In this regard, he has published five papers so far. His three years stint at the RPE laboratory has enable him to provide technical advice to client, on invitation.

Figure 2.0 DML Personnel

Technical Officer (TO)

Seated on the right is **Haalah binti Mahmud, Technical Officer** who is another SAMM Signatory for DML. Besides conducting the laboratory testing, she is also active in doing research and collaborates with other organisations especially related to testing. Since this field is very broad in scope, she hopes to get exposed to as many technical areas possible and be one of the experienced in laboratory testing.

2.2 DUST MASK LABORATORY (DML) SERVICES

1) Third-party laboratory – Malaysian Certification (DOSH/SIRIM Approval)
2) Full/Partial Tests under:
    i. MS 2323:2010 (EN149:2001)
    ii. MS 2490:2012 (EN140:1998)
    iii. MS 2553:2014 (EN143:2000+A1:2006)
3) Fit Testing for Respiratory Protective Equipment
4) Collaboration in R&D
5) Provide facilities for Respiratory Protective Equipment practical training

2.3 RESEARCH ACTIVITIES

Besides performing laboratory tests, DML is currently conducting a study on The Level of Bacteria Contamination, and Effectiveness of Facemask by Working Environment, Wearing Time and, Skin Physiology. This study involves NIOSH Bangi staff as subjects and collaborates with other laboratories under OSHECT, which are Face Mask Medical Laboratory (FMML) and Chemical Hazardous to Health Laboratory (CHL).

The expected outcome of this study is to come up with a general guideline for facemask usage among office workers. Below are the parameters that will be determined during the study:

i. Bacteria contamination: Colony-forming Unit (CFU) and bacteria species
ii. Facemask effectiveness: Penetration and Breathing Resistance test under MS2323:2010
iii. Skin physiology: Temperature and trans-epidermal water loss (TEWL)

Throughout the study, lecturers from local universities are invited to share their feedback and expertise. The study is conducted for 18 months starting from May 2022.

2.4 OTHER ACTIVITIES

DML is in the process of obtaining recognition from the British Standard Institution (BSI) as one of its panel laboratories. By obtaining their recognition, DML will be able to perform laboratory tests on respirators that wish to get European Standard (EN).

Table 1.0 Dust Mask Laboratory (DML) Activities

Item	Activities/Organization	Year
Accreditation	ISO 17025:2017	2021
Appreciation Award	Kementerian Kesihatan Malaysia (KKM)	2021
	Jabatan Kesihatan Negeri, Negeri Sembilan, KKM	2020
Talks/Sharing	Live-streaming MyDigital.KKMM by Kementerian Komunikasi dan Multimedia Malaysia (KKMM): Bolehkah Alat Perlindungan Pernafasan Melindungi Kita?	2021
	NIOSH Virtual Tours: Dust Mask Laboratory (DML)	2021
	NIOSH OSH Talk: Unmasking the Truth About Mask	2020
	Sharing on Respirators for Universiti Malaysia Terengganu	2020
	Sharing on Respirators at Sekolah Rendah Agama Integrasi (SRAI), Bangi	2020
	Seminar on Respirators	2020
Exhibition	100 Hari Aspirasi Keluarga Malaysia	2021
Collaborations	Kementerian Kesihatan Malaysia (KKM)	2019
	Medical Device Authority (MDA)	2020
	Polis Diraja Malaysia (PDRM)	2020
	Kementerian Pelajaran Malaysia (KPM)	2020
	Agensi Nuklear Malaysia	2020
	Forest Research Institute Malaysia (FRIM)	2020
	Kementerian Dalam Negeri dan Hal Ehwal Pengguna (KPDNHEP)	2020
	Institute Medical Research (IMR), KKM	2021
	Universiti Sains Malaysia (USM)	2020
	Universiti Tun Hussien Onn Malaysia (UTHM)	2020
	Universiti Teknologi Mara (UiTM)	2020
	Universiti Malaysia Terengganu (UMT)	2020
	University Islam Antarabangsa (UIA)	2020
	Universiti Malaysia Sarawak (UNIMAS)	2021
Published Papers/Infographics	Please scan the QR code below	20202022

2.5 ACCREDITATION AND PHOTOS

KEMENTERIAN KESIHATAN MALAYSIA

Sijil Penghargaan

Dengan ini merakamkan setinggi-tinggi penghargaan kepada

DUST MASK LABORATORY (DML)
NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

Di atas sumbangan dan komitmen kolaborasi dalam menjalankan

RESPIRATOR PENETRATION TEST
Standard MS2323 : 2010

Semasa Pandemik COVID-19

DATO' DR. ASMAYANI KHALIB
Timbalan Ketua Pengarah Kesihatan (Perubatan)
Kementerian Kesihatan Malaysia

SIJIL PENGHARGAAN

JABATAN KESIHATAN NEGERI
NEGERI SEMBILAN DARUL KHUSUS

Dengan ini merakamkan setinggi-tinggi penghargaan dan terima kasih kepada

NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

atas kerjasama menyumbang bantuan teknikal " Peneration Test" bagi Respirator N95 untuk kegunaan petugas kesihatan

(DATIN DR. HARLINA BINTI ABD. RASHID)
Pengarah Kesihatan Negeri
Jabatan Kesihatan Negeri Sembilan Darul Khusus

Figure 2.1 Seminar of Respirators

Figure 2.2 Sharing on Respirators at Sekolah Rendah Agama Integrasi, Bangi

Figure 2.3 Collaboration with Kementerian Kesihatan Malaysia (KKM)

Figure 2.4 Conducting fit test on medical staffs at Hospital Sg. Buloh

Figure 2.5 NIOSH OSH Talk (FB Live)

Figure 2.6 Arrival of the equipment on 2018

Figure 2.7 Training with INSPEC in 2018

Figure 2.8 NIOSH Virtual Tours: Dust Mask Laboratory (DML)

EFFECT OF DECONTAMINATION METHODS ON THE FILTER PARTICLE PENETRATION, BREATHING RESISTANCE AND MORPHOLOGY OF FILTERING FACEPIECE RESPIRATORS

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Abstract. Filtering Facepiece Respirators (FFR) have been used by healthcare workers in their working activities. However due to scale of breakout, FFR are becoming short and insufficient to cope with demand, thus the potential decontamination methods need to be identified. The present study is aimed to evaluate the performance of three different models of FFR when exposed to three decontamination methods; vaporized hydrogen peroxide (VHP), bleach and autoclave. Filter particle penetration and breathing resistance penetration and relationship to the FFRs microstructure was performed. Scanning Electron Microscope (SEM) was used to observe the morphology property of the FFR. Comparison with the control samples indicated that Model 1 exhibited the lowest average filter penetration than those Models 2 and 3. After bleach decontamination of the FFR, high deviation of particle penetration and breathing resistance penetration data from the control was observed. This is due to the FFR structure degradation. Based on the study, it is found that all models showed acceptable filter particle penetration and breathing resistance even after most aggressive testing conditions used for the three decontamination methods.

Keyword: Filtering face respirators, decontamination, filter, penetration, resistance

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ORIGINAL ARTICLE

Household Materials for Homemade Masks: How Effective Are They?

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ABSTRACT

Introduction: With the fear of uncertain behaviours and mechanisms of the coronavirus in the rapidly evolving COVID-19 pandemic, people are required to cover their mouth and nose to prevent the spread of the virus. This has become a challenge as most countries struggle with the dwindling stocks of face masks. However, the Centers for Disease Control and Prevention suggested the use of cloth masks as a substitute. In an effort to find suitable materials that serve this purpose and ensure sufficient protection afforded, the masks need to be tested. **Methods:** In this study, the penetration and breathing resistance of 13 easily obtained household materials potentially used by the public as face masks, were randomly selected and tested by using TSI Model 8130 Automated Filter Tester, while the thickness was measured by S-Cal EVO Proximity caliper. **Results:** The level of thickness ranged between 0.25 mm (satin) and 4.83 mm (diaper). Double-layer denim material showed the lowest percentage of penetration (Median, IQR: 27.50%, 27.05-28.80) while the greatest was single-layer lycra (Median, IQR: 90.60%, 80.80-92.10). Single-layer chiffon fabric showed the best breathing resistance (Median, IQR in mmH$_2$O: 1.30, 0.90, 1.45) while the worst was diaper (Median, IQR in mmH$_2$O: 87.20, 86.95, 87.25). **Conclusion:** Double-layer dried wet tissue, single-layer tissue paper and double-layer non-woven fabric can be considered to be used as face masks due to their efficiency based on penetration and breathing resistance factors.

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Market Surveillance of Filtering Facepiece (FFP)of Respirator Protective Equipment (RPE): Malaysian Perspectives

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Abstract. Filtering Facepieces (FFPs) are commonly use as personal protective equipment (PPE). It is disposible Respiratory Protective Equipment (RPE). Basically it is used for protection against dusts, particles and aerosols. Available in 3 classes FFP1, FFP2 and FFP3. Various Respiratory Protective Equipment (RPE) offered in Malaysia's market today are not being controlled and monitored by expert bodies and authorities. This has led to various perceptions among the users, especially on the quality and safety and health features of the products offered by different companies. This situation also makes it difficult for users to decide

GAS MASK LABORATORY
(GML)

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GAS MASK LABORATORY (GML)

Nor Mohd Razif Noraini

3.1 INTRODUCTION

Respiratory Protective Equipment Testing laboratories is a NIOSH initiative to further strengthen its position as a competitive National Occupational Safety and Health Institution. The process of setting up these test laboratories has gone through several important phases from the beginning of the proposal by NIOSH itself to establish a PPE test laboratory for R&D and commercialization purposes. Convinced again by the offer of DOSH Malaysia to NIOSH to create this laboratory, the work towards its establishment has begun in the year 2007 by the Industrial Hygiene Division under the Consultation, Research & Development Department. Gas Mask Laboratory is one of the subsidiaries under RPETL and a part of the laboratory under the Occupational Safety and Health Evaluation and Control Technology Center of NIOSH Malaysia. This laboratory was funded under 'Rancangan Malaysia Kesebelas (RMK-11)'. The function of this laboratory is to conduct analysis on aspects of occupational safety and health. The existence of this center is also to verify and ensure that respiratory protective equipment offered in the market meets the set standards before being sold and used. The international collaboration on the design of this laboratory has been recorded with several countries and experts such as the Korean Safety and Health Agency (KOSHA) of South Korea, INSPEC International Ltd of United Kingdom (UK), ProQares of Netherlands and Draeger of German. Then, GML come into operation in the year 2022.

3.2 PROJECT DIRECTION

Establishment of Gas Mask Laboratory (GML)

NIOSH's direction is to become a center of excellence for OHS related to PPE testing in the region with the establishment of this laboratory. NIOSH is also committed to conducting intensive research to fulfill its responsibilities to the nation and society. Therefore, NIOSH will

make this laboratory one of the strengths to provide international standard services. Indirectly, he will be an ICON of NIOSH Malaysia's **existence.**

3.3 THE RATIONALE FOR THE ESTABLISHMENT OF GML

The objective and functions of the Gas Mask Laboratory (GML)

1. Empowering Research and Development (R&D)

The field of R&D is undeniably important to conduct proper studies on the use of RPE in Malaysia in particular. The existence of an extensive supply of RPE in the market based on international standards does not fully guarantee its suitability for use in Malaysia. The initial phase of establishing this laboratory is to provide a technological facility for testing and certifications. The laboratory is also used as a research and development platform that is responsible for the study of RPE in the country.

Generally, the objective of establishing national institutions in the field of R&D-oriented occupational safety and health are to obtain new knowledge, which may be used in practice. In accordance, the objective of establishing a PPE testing laboratory for R&D aims to obtain new knowledge applicable to the company's business needs, which will ultimately translate the applications to develop new products or to improve processes, and systems in creating better services that can increase business volume and profits.

Thus, the need to emphasize that R&D is essential to create new or better technologies which can in turn be transformed through technology management into competitive advantages at the business, corporate and national levels. Although the process of technological innovation through R&D is complex and risky, the rewards can be very high, as evidenced by many companies in Malaysia as well as overseas.

2. Providing 'Third Party Testing Laboratory' services

Third Party Testing Laboratory is an independent laboratory that provides third party testing facilities without being influenced by any person or organization. This laboratory is independent because it is not affiliated with the manufacturers as well as the tested items which promise biased results for commercial purposes. This contracted test facility is referred to as a third-party testing or local assessment facility.

3. Potential new service offerings that promise a return on investment

As a well-known national institution, the provision of new services is essential to the promise of continued service and returns that can cover existing operations. Therefore, with the establishment of this laboratory, NIOSH Malaysia will provide the first new service in Malaysia without existing competition. The return on investment should be positive for profits, facilities and also human resource development.

4. Introduction to NIOSH Marking

The NIOSH Mark on a product is a declaration to customers that the product complies with essential requirements of safety, health and environmental protection standards. The NIOSH Mark is an important indicator of a product's compliance with the law and ensures the free movement of products in the Malaysian market. By affixing the NIOSH Mark to a product, the manufacturer declares its responsibility to comply with all legal requirements to obtain the NIOSH Mark, thereby guaranteeing the authenticity of the product offered for sale throughout Malaysia.

The NIOSH Mark on the product indicates to all governmental authorities that the product may be used in accordance with regulatory specifications for the local market. NIOSH Marking is a self-certification scheme. This makes sense, as certain product categories must pass certain types of testing by an independent organization against certain technical standards.

5. Supporting National Enforcement Agencies and Government Bodies as National Centers of Excellence in the Field of Occupational Safety and Health.

In essence, NIOSH was established based on the Department of Occupational Safety and Health (DOSH), Ministry of Human Resources. NIOSH is a center of excellence in the field of occupational safety and health (OSH) to develop knowledge combining expertise and skills from various fields. NIOSH plays a role in original and pioneering research to provide knowledge leadership in the form of policy development and technology development to the community nationally and internationally. Centers of excellence come in various forms such as training institutions, research centers and research laboratories.

6. Consulting and Training Services

As a national institute of excellence, it certainly has the technological facilities, qualified sources of expertise as well as professionals who are recognised within this organization. Emphasis will be placed on these centers of excellence to meet the general needs in realizing their respective objectives. As such, this center of excellence will offer the following profitable services;

GML was developed to meet Malaysia's need for comprehensive testing of chemical gas masks required for use by workers, the public and the military. In addition, GML will assist stakeholders including government and private such as authorities, agencies, local and international manufacturers, importers, researchers and all interested parties to obtain advanced testing equipment and experts for reference. The establishment of GML is to perform laboratory testing according to local and international standards. Henceforth, GML fulfills several tests for chemical gas masks to comply with Malaysian Standards (MS), European Standards (EN) and American Standards (NIOSH).

3.4 GML TESTING SERVICES

ACCORDING TO MS 2554:2014 and EN14387:2004

Mechanical Strength (M.S.)

- The ability of the filters shall show no mechanical defect and meet the requirement of the standards.

Temperature Conditioning (T.C.)

- The filters will be subject to the temperature conditioning test. There is should be no sign of damage after the process.

Breathing Resistance

- Several filters shall be tested the resistance imposed to the flow of air and need to be as low as possible.

Gas Capacity

- Determination of minimum breakthrough time at the test condition with specific test gas concentration in air.

GML Testing Facilities

Figure 3.0 Gas Mask Laboratory Entrance

Figure 3.1 Gas Testing Chamber

Figure 3.2 Main Supply Gaseous

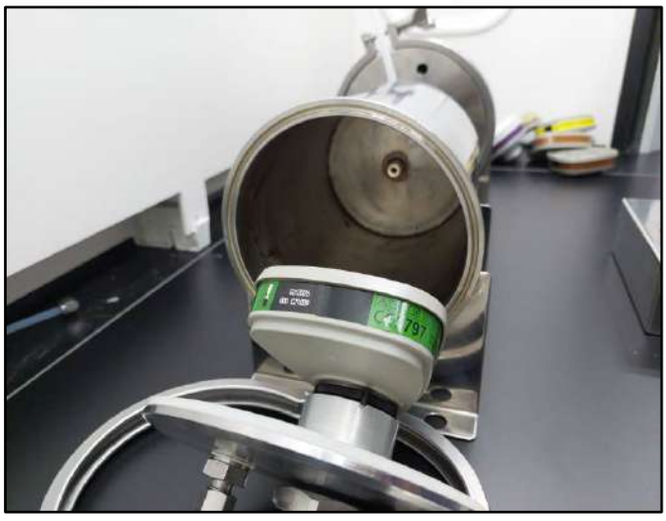

Figure 3.3 Tested Filter In Chamber

Figure 3.4 The Chambers

Figure 3.5 Integrated Filter Testing System (IFTS)

Figure 3.6 Study Visit to KOSHA, South Korea

Figure 3.7 Military Gas Mask Manufacturers Visit of South Korea

Figure 3.8 KOSHA Gas Mask Expert with NIOSH Study Visit Members

Figure 3.9 KOSHA Directors with NIOSH Study Visit Members

Figure 3.10 KOSHA Gas Mask Testing Facility

Figure 3.11 KOSHA PPE Certification Centre

3.5 BIBLIOGRAPHY OF TEAM MEMBERS

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- Bachelor of Chemical Engineering, Universiti Teknologi MARA (UiTM)

FACE AND MEDICAL MASKS LABORATORY (FMML)

4

FACE AND MEDICAL MASKS LABORATORY (FMML)

Nor Mohd Razif Noraini, Nor Shahirah Md Izuddin

4.1 INTRODUCTION TO FACE AND MEDICAL MASKS LABORATORY (FMML)

The Respiratory Protective Equipment Testing Laboratory (RPETL) is a cluster of laboratories specifically designed for the Respiratory Protective Equipment (RPE) testing centre and was built by NIOSH as an initiative to further strengthen its position as a competitive National Occupational Safety and Health Institution.

The Face and Medical Masks Laboratory (FMML) is one of the laboratories under RPETL and was simultaneously put into operation during the COVID-19 pandemic alarming the world. The COVID-19 pandemic, which is classified as a biohazard, requires a dedicated laboratory for testing PPE control equipment such as face masks and 'suits'. This can help the country by offering quality control testing to manufacturers and importers in Malaysia before offering face masks and “suits” to industry, employers, employees and the general public. The presence of products that do not conform to specifications, illegal certification and influx of counterfeit products into the Malaysian open market will endanger the safety and health of consumers due to infections and adverse events such as shortness of breath, etc. are also recorded around the world.

The accelerated development of FMML provides the country with advanced and comprehensive laboratory facilities in line with the current situation in the country and the world that requires expertise in face masks and medical mask testing.

Expectation and support from stakeholders such as the Ministry of Occupational Safety and Health, Ministry of Health Malaysia, Ministry of Domestic Trade and Consumer Affairs, Association of Face Mask and Medical Respirator Manufacturers, public and private

universities and health and safety professionals in work, was fulfilled and receiving good responses. In this regard, international parties such as the ASEAN Occupational Safety and Health Research Institute (AOSHRI) partner of NIOSH and Sri Lanka are expected to cooperate in developing PPE-related testing expertise.

FMML was developed to meet Malaysia's need for comprehensive testing of face and medical masks required for use among the public, healthcare workers and frontline workers.

Face masks and medical respirators are one type of personal protective equipment under the respiratory protective equipment criteria. Unlike dust masks or easily recognized by the introduction of N95 or FFP, face masks and medical respirators are more geared towards protection against biological hazards. There are several types of masks of this type that are used in major industries such as medical, hospitality, food handling, electronics, industry requirements related to ‘clean room’ and others.

4.2 USE OF FACE AND MEDICAL MASKS IN MALAYSIA

Protection against biological hazards is one of the elements of occupational safety and health. The presence of harmful airborne particles suspended in the air such as bacteria and viruses requires respiratory protective equipment that meets the criteria to protect the wearer from exposure to airborne diseases. Therefore, the introduction of measures to identify the type of face mask and medical respirator which is one of the PPE should be strengthened in Malaysia. This can be done by intensifying the testing of this equipment which is made in Malaysia and also imported from abroad. Consumers in Malaysia will be clearer and easier to select equipment in the market once a valid test by an accredited laboratory is completed and certainly inclusive of the certification process on product quality control before it is marketed.

In addition, FMML will assist stakeholders, including government and private, such as authorities, agencies, local and international manufacturers, importers, researchers and any interested parties to obtain advanced testing equipment and inclusive experts’ advice.

Figure 4.0 BS EN 14683:2019, Medical Face Mask – Requirements and Test Methods

The establishment of FMML is to conduct laboratory testing according to local and international standards. From now on, FMML to fulfill several testing for face and medical masks according to Malaysian Standards (MS), European Standard (EN), American Standards (ASTM/NIOSH) and China Standard (YY/GB).

Figure 4.1 ASTM, F2100_21 Performance of Materials Used in Medical Face Masks

4.3 FMML TESTING SERVICES

ACCORDING TO MS ISO 22609:2011/MS 2489-1:2012/EN14683/ASTM F2101/

ASTM F2299/ASTM 1862/MS 36954C/16 CFR PART 1610

Bacterial filtration efficiency (BFE)

- The ability of the face mask to filter bacteria so that they are not released into the user's surroundings (BFE), (%).

Differential pressure or Delta P (pressure differential)

- Measures the airflow resistance of the mask and is an objective measure of breathability. The lower this value, the easier it is for the user to breathe normally (Pa/cm2).

Splash resistance pressure or Fluid Resistance

- Reflects the mask's ability to minimize the amount of fluid that could transfer from the outer layers through to the inner layer as the result of a splash or spray. : The ability of the face mask to withstand the penetration of liquid splashes (kPa).

Particulate Filtration Efficiency (PFE)

- Measures how well a mask filters sub-micron particles with the expectation that viruses will be filtered in a similar manner. The higher the percentage, the better the mask efficiency. (%)

Flammability

- The test is used to is to determine the fire resistance performance of face masks. Operating rooms contain sources of oxygen and other gases used for anesthesia, and there are potential fire hazards from electrosurgical procedures such as lasers or cautery equipment.

Physical Strength Test of Masks:

- Testing the physical strength of the ties of the medical mask in accordance with standards will ensure that the ties can withstand the force used when applying the mask and that the constant force that is added when the mask is in use will keep the mask intact.

Table 2.0 Development Activities

No	Activity	Date
1.	Equipment Training	21/10/2021 – 5/11/2021
2.	Introduction to MS ISO/IEC 17025:2017 Training	15/02/2022
3.	MS ISO/IEC 17025:2017 Measurement Uncertainty Training	16/02/2022
4.	MS ISO/IEC 17025:2017 Method Validation Training	17/02/2022
5.	Short Research on Breathability Testing	06/04/2022
6.	Exhibition : Program Sambutan Hari Keselamatan Dan Kesihatan Pekerjaan Sedunia (WOD 2022)	28/04/2022

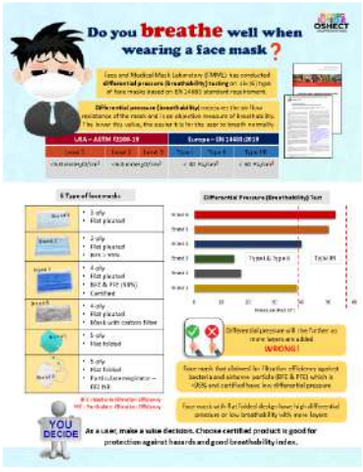

Figure 4.2 Infographics

4.4 ACTIVITY

Preparing for ISO/IEC 17025:2017 Accreditation Certificate

4.5 FMML EQUIPMENT AND FACILITIES

Figure 4.3 FMML signage

Figure 4.4 Particle Filtration Efficiency Tester (PFE)

Figure 4.5 Air Flow Resistance & Differential Pressure Tester

Figure 4.6 Training session on Bacteria Colony Counter

Figure 4.7 Bacteria Filtration Efficiency Tester (BFE)

Figure 4.8 Training session on Bacteria Filtration Efficiency Test (BFE)

Figure 4.9 Tensile Tester

Figure 4.10 FMML lab equipment

4.6 BIBLIOGRAPHY OF TEAM MEMBERS

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Designation:

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Designation:

- Technical Expert III, Consultation, Research & Development Dept. (CRDD), NIOSH
- Laboratory Advisor (LA), OSHECT

Education:

- Bachelor of Materials Engineering, Universiti Sains Malaysia (USM)

Name: Mrs. Nor Shahirah Binti Md Izuddin

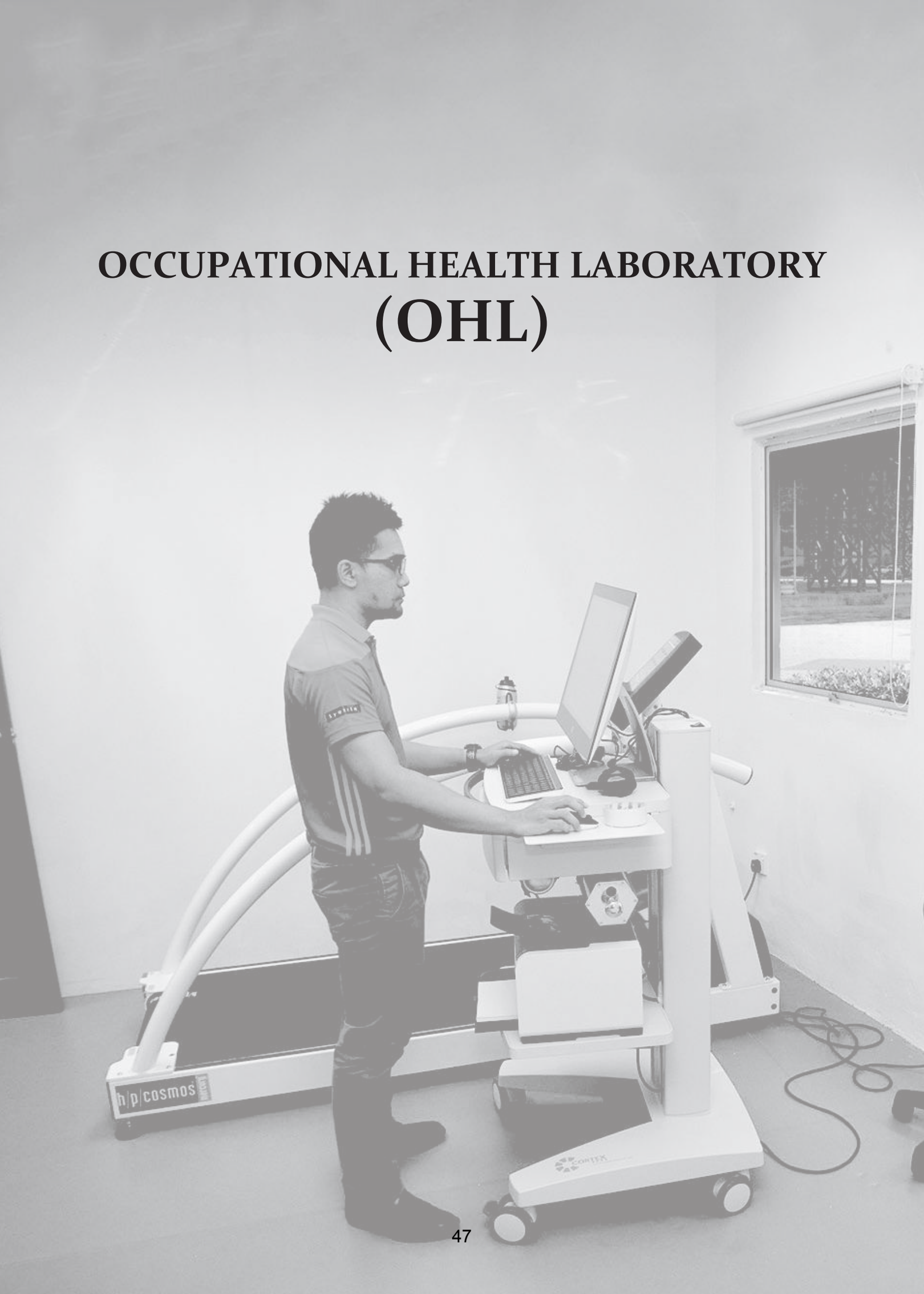
Designation:

- Executive, Consultation, Research & Development Dept. (CRDD), NIOSH
- Technical Officer (TO), OSHECT

Education:

- Master of Science (Marine Science), Universiti Kebangsaan Malaysia (UKM)
- Bachelor with Honours (Marine Science) Majoring in Biology, Universiti Kebangsaan Malaysia (UKM)

OCCUPATIONAL HEALTH LABORATORY (OHL)



5

OCCUPATIONAL HEALTH LABORATORY (OHL)

Dr Muhamad Ariff Muhamad Noordin, Siti Nurani Hassan, Ahmad Syazrin Muhammad, Mohd Nur Ikhwan Shafiee, Nur Alyani Fahmi Salihen

5.1 INTRODUCTION TO OCCUPATION HEALTH LABORATORY (OHL)

Occupational Health Laboratory (OHL) was established in 2016 under RMK-11. As the sub-unit under the Occupational Health Centre, this laboratory support most of the occupational health issues and services specifically on Total Wellness and Health Promotion (TWHP). The testing includes physical body composition analysis, cardiovascular exercise, and human performance testing. All the analysis was conducted with consultation for the exercise prescription and cardiac rehabilitation programme. In conjunction with Sustainable Development Goals 2030 (SDG), the aims of good health and well-being include the reduction of premature mortality from non-communicable diseases through prevention, treatment, and promotion of well-being including mental health.

Figure 5.0: Set of equipment for maximal oxygen consumption testing to measure the maximum rate of oxygen taken in and used by the body per minute while exercising

In the 4 years of its operation, OHL has done over 700 body composition analyses and cardiovascular exercise testing for companies and internal NIOSH staff. Besides that, OHL conducting research on occupational fitness and human working productivity regarding publishing the current fitness and productivity of the human workforce specifically in Malaysia. Thus the guideline for fitness for work within most occupational sectors can be established.2.2

5.2 THE OBJECTIVE AND FUNCTIONS OF THE OCCUPATIONAL HEALTH LABORATORY (OHL)

Occupational Health Laboratory Function

1. Provides research and development on occupational health and fitness
2. A reference centre and leader in occupational health and fitness
3. Conduct testing and certified data sampling for public use and enforcement
4. Information centre for occupational health and fitness.
5. Leading laboratory provider for occupational fitness laboratory testing in Southeast Asia

5.3 TRAINING COURSES OFFERED BY OCCUPATIONAL HEALTH LABORATORY (OHL)

NIOSH courses had been using OHL facilities, such as Total Wellness and Health Promotion (TWHP) and Back Protection Programme. Both programmes aim to protect the workers from work-related injuries caused by ergonomic risk factors or non-work-related diseases such as hypertension, diabetes, and cardiovascular diseases. By utilising facilities such In-Body Body Composition Analysis, our laboratory helps the industry to screen and filter any workers with the risk of developing diseases. For example, In-Body Body Composition analysis can help the employer through to screen any workers with low muscle mass. Low muscle mass has been found to increase the risk of musculoskeletal injuries (MSI), especially among workers with manual handling activity. In addition, if the workers have a high body fat percentage, it may indicate sarcopenic obesity, which increases the risk of developing MSI and non-communicable diseases.

5.4 PHOTO GALLERY

Figure 5.1 Abdominal obesity measurement

Figure 5.2 Body composition analysis

Figure 5.3 Clinical VO2max

Figure 5.4 Fitness VO2max

Figure 5.5 Lower body strength test

Figure 5.6 Electrocardiogram Resting Test

Figure 5.7 Grip strength test

Figure 5.8 Endurance muscle strength test

Kekal aktif, produktif di tempat kerja

Februari 25, 2019 @ 10:00am

Oleh Mahani Ishakmahani@bh.com.my

Siti Nurani (kiri) melakukan pemeriksaan kesihatan pekerja di NIOSH, Bandar Baru Bangi. - NSTP/Mohd Khairul Helmy Mohd

Figure 5.9 OHL services in Berita Harian online newspaper

5.5 OCCUPATIONAL HEALTH LABORATORY (OHL) ACHIEVEMENTS AND COLLABORATIONS

Figure 5.10 Collaboration technical sharing training on the maximal oxygen consumption (VO_2max) testing *at Faculty of Sport and Health Sciences, Department of Organization and Management, Teaching and Educational Centre & Measurement Technology under the Laboratory Organization in Munich, Technical University of Munich, Germany.*

CHEMICAL HAZARDOUS TO HEALTH LABORATORY (CHL)

6

CHEMICAL HAZARDOUS TO HEALTH LABORATORY (CHL)

ChM. Mohd Norhafsam Maghpor, Zakiah Mohd Yusoff, Siti Nazhatul Marina Mior Iskandar, Aqilah Nabihah Omar, Shafina Nadiawati Abdul, Rochi Anak Bakel, Nor Fitriyana Mohd Yusof, Muhammad Muhseyn Zulkurnain

6.1 INTRODUCTION TO CHEMICAL HAZARDOUS TO HEALTH LABORATORY (CHL)

In 2000, the Use and Exposure Standards of Chemicals Hazardous to Health (USECHH) Regulations were introduced to strengthen the legislation in which all chemicals hazardous to health are controlled under its clause. The Industrial Hygiene Analytical Laboratory was established as part of the Industrial Hygiene Division in the late 1990s to conduct research and support the surveillance activities of the IHD.

In 2005, laboratory services were commercialized and offered to the Occupational Health Doctor and Industrial Hygiene Technician (IHT1), DOSH competent person to test a biological sample and an environmental sample respectively. The aim was to help industries strengthen industrial hygiene testing as well as help the employer comply with legislation through laboratory testing. During the first years of operation, few samples were taken and analyzed each year, but it increased to almost ten thousand samples after almost two decades of operation, except for more than fifteen thousand samples in 2015.

Under the Eleventh Malaysia Plan (11th MP), the Malaysian government, through the Ministry of Human Resources, provided funds to NIOSH Malaysia to develop an integrated OSH laboratory. Known as the Technology Center for OHS Risk Assessment and Control, the project was developed from 2016 to 2020. The overall objective of the project is to provide support facilities for activities at NIOSH Headquarters in Bandar Baru Bangi and at the South Johor Region Campus. Within the framework of OSHECT, the IHAL has been renamed Chemical Hazardous to Health Laboratory (CHL).

6.2 THE OBJECTIVES OF THE ESTABLISHMENT OF THE CHEMICAL HAZARDOUS TO HEALTH LABORATORY (CHL)

The main objective of the CHL is to assess the level of worker exposure to health-hazardous chemicals and microbes in the workplace while helping the industry comply with local legal requirements. Unique, compared to other laboratories in Malaysia, CHL is a niche for occupational safety and health testing, especially industrial hygiene. It continues to offer testing and sample analysis primarily in the area of industrial hygiene, including:

- Workplace environmental sample – sampled by Hygiene Technician (IHT1) as per the requirement under Part VIII of USECHH 2000 (Monitoring of Exposure at the Place of Work)
- Biochemical samples such as urine and blood - by Occupational Health Doctor (OHD) as per requirement under Part IX of USECHH 2000 (Health Surveillance)
- Microbiological samples - by indoor air quality assessor to complement the Industry Code of Practice of Indoor Air Quality, 2010

The CHL is equipped with state-of-the-art scientific equipment such as Inductively Coupled Plasma Mass Spectrometry, Mercury Analyser, Ion chromatography (IC), Phase contrast microscope (PCM), X-ray Diffractometer (XRD), and Gas Chromatography. The CHL offers an analysis of various parameters from particles, solvents, and heavy metals, both organic and inorganic. Most of the test methods are referred to as internationally recognized test methods such as the NIOSH Manual Analysis Method (NMAM). Chemical Hazardous to Health Laboratory (CHL) accredited by Department Standard Malaysia under Skim Akreditasi Makmal Malaysia based on ISO/IEC 17025 was completed in 2009. SAMM ID number for CHL was 412 with only 5 parameters. Then, in 2020, the CHL accreditation was extended to 52 test parameters.

6.3 THE ACHIEVEMENTS OF THE CHEMICAL HAZARDOUS TO HEALTH LABORATORY (CHL)

In 2011, for the first time, IHAL (now known as CHL) received the Excellent Laboratory Award organized by the Malaysian Institute of Chemistry (IKM). The award is recognition for laboratories that have achieved competence in the practice of analytical work. The award is a recognition to laboratories that have achieved competency in the practice of analytical work. In addition, the award was designed to ensure the laboratory's commitment to achieving excellence in providing quality and competent testing services on local legislation, especially in the fields of safety, health and the environment. IHAL has proven its excellence in laboratory services by consistently receiving the award for ten consecutive years. This 10-year award is known as the IKM Laboratory Excellence Silver Award.

Through cooperation, in addition to the NIOSH-JICA program, CHL also cooperates with several other domestic and international agencies such as the Korean Occupational Safety and Health Agency (KOSHA), the Malaysian Institute of Chemistry (IKM) and local Universities.

Equipment list and activities in CHL

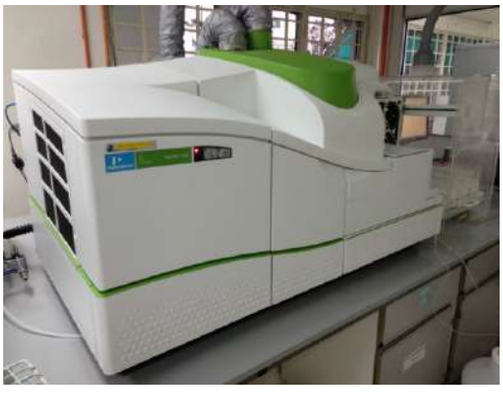


Figure 6.0 Gas Chromatography (GC)

Figure 6.1 Gas Chromatography (GC)

Figure 6.2 Inductively Couple Plasma Mass Spectrometry (ICP-MS)

Figure 6.3 Inductively Couple Plasma Mass Spectrometry (ICP-MS)

Figure 6.4 Microscope

Figure 6.5 Mercury Analyser

Figure 6.6 X-ray Diffraction (XRD)

Figure 6.7 Ion Chromatography (IC)

Figure 6.8 High-Performance

Figure 6.9 Analytical Balance Liquid Chromatography (HPLC)

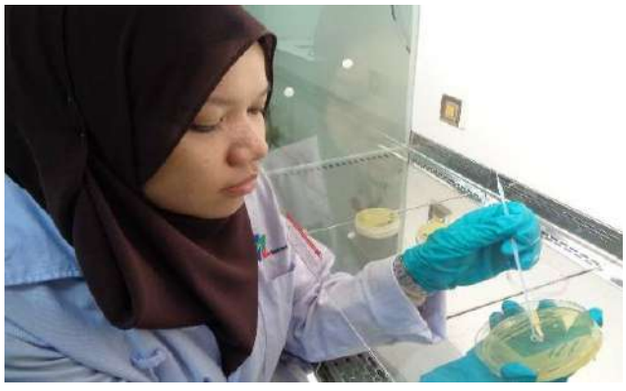


Figure 6.10 Microbe Analysis

Figure 6.11 Microbe Analysis

STANDARDS MALAYSIA

Certificate of Accreditation

No. SAMM 412 Accredited since: 21 January 2009

This is to certify that

INDUSTRIAL HYGIENE ANALYTICAL LABORATORY
NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY & HEALTH (NIOSH)
BANDAR BARU BANGI, SELANGOR
MALAYSIA

has been granted accreditation in respect of the scope of accreditation described in the schedule, subject to the terms and conditions governing the Skim Akreditasi Makmal Malaysia (SAMM), the Laboratory Accreditation Scheme of Malaysia.

Laboratories accredited under SAMM meet the requirements of MS ISO/IEC 17025. This Malaysian Standard is identical with ISO/IEC 17025 published by the International Organization for Standardization (ISO).

(DATUK SAIDAH BAHARIN)
Director/General
Department of Standards Malaysia

Date of issue: 05 January 2018

Figure 6.12 Certificate of Accreditation ISO 17025: 2017

Certificate of IKM Laboratory Excellence Award (2011 – 2021)

Figure 6.13 Certificate of IKM Laboratory Excellence Award (2011 - 2021)

SCIENTIFIC EQUIPMENT CALIBRATION LABORATORY (SECL)

7

SCIENTIFIC EQUIPMENT CALIBRATION LABORATORY (SECL)

Fadzil Osman, Muhamad Zulazhar Abdul Halim, Azrulazswan Abd Haddi

7.1 INTRODUCTION TO SCIENTIFIC EQUIPMENT CALIBRATION LABORATORY (SECL)

The existence of the Factories and Machinery Act 1967 and the Occupational Safety and Health Act 1994 clearly shows the importance of OSH in the workplace. The main goal of the acts is to create a safe and healthy culture among all workers and employers in Malaysia. Among the issues of concern is an increase in occupational disease causes related to hazardous chemicals, ergonomics and noise exposure.

Despite all efforts and promotions taken by the enforcer, employers and OSH practitioners, occupational diseases and poisoning are still major issues in safety and health in Malaysia. The number of reported cases is increasing every year.

New regulation on noise was implemented in Malaysia on 2019, Under OSHA 1994 (Noise Regulation) there is some amendment to previous regulation where industry/employer needs to identify their source of noise annually (Identification of excessive noise, ICOP on Management of Occupational Noise Exposure and Hearing Conservation 2019). There are many types of identified noise sources which are human hearing (depending on the individual), Sound Level Meter (SLM) and other methods. To comply with the regulation, the equipment that has been used to monitor the exposure needs to be calibrated to assure the efficiency of that equipment.

7.2 NIOSH SCIENTIFIC EQUIPMENT CALIBRATION LABORATORY (SECL)

Under the Eleventh Malaysia Plan (11th MP), NIOSH Malaysia has been funded by the Government of Malaysia through the Ministry of Human Resources to develop Scientific Equipment Calibration Laboratory (SECL) as a part of the OSH Hazard Evaluation and Control Technology Centre (OSHECT) development. The calibration laboratory can calibrate sound measurement equipment (sound level meter, dosimeter and field calibrator) as per required under IEC 61672**.**

7.3 OBJECTIVE OF SECL

1. To provide calibration service for sound measurement equipment.
2. To be certified as a calibration laboratory under international standards.
3. To reduce market price for equipment calibration.

Table 3.0 SECL Equipment, Function & Applications

BIL	NAME OF EQUIPMENT	FUNCTION & APPLICATION
1	General Acoustic Calibration System (Anechoic Chamber)	This equipment is designed to calibrate sound pressure equipment including Sound Level Meter, Dosimeter, Electroacoustic Microphone, and Acoustic Calibrator that supports both an anechoic chamber method and a coupler method for IEC Standard Calibration Procedure
2	Precision Waveform Generator	Operating modes: Continuous, modulate, frequency sweep, burst, output gate
3	Programmable Audio Signal Attenuator	This system can provide an audio signal attenuator to the DC to 200kHz, and also the setting of the dial operation of the panel surface, GP-IB.
4	Multi-function Audio Analyzer	The audio analyzer must be equipped with a low distortion signal source and AC level measurement, DC Level, Distortion, SINAD and Frequency Measurement Function

5	Reference Sound Level Meter	The integrated comparator function is convenient for use in measurement and monitoring and calibration system
6	Reference Acoustic Calibrator	Integrated feedback control reference microphone
7	Acoustic Measurement Control System	Able to the coupler in with the speaker for amplification

Figure 7.0 Equipment training from RION Japan to enhance capability in handling equipment in 2019

Figure 7.1 ISO 17025 Training to develop documentation for certification

Figure 7.2 Sharing knowledge on equipment and needs for calibration

7.4 RESEARCH ON EQUIPMENT CALIBRATION

New regulation on noise was implemented in Malaysia in 2019 under the Occupational Safety and Health Act 1994. There are some amendments to previous regulations where industry/employer needs to identify their source of noise annually. (Identification of excessive noise, ICOP on Management of Occupational Noise Exposure and Hearing Conservation 2019). There are many types to identify noise sources which are human hearing (depending on the individual), Sound Level Meter (SLM), and other methods. One of the simple and convenient ways is by smartphone noise application.

Smartphones have evolved into powerful computing machines with exceptional capabilities: Most now have built-in sensors such as microphones, cameras, global positioning system (GPS) receivers, accelerometers, gyroscopes, and proximity and light sensors. Smartphone developers now offer many sound measurement applications (apps) using the devices' built-in microphone (or through an external microphone for more new apps). Interest in such sound measurement apps is growing among audio enthusiasts, educators, acoustic and environmental researchers, and the public. More than 100 iOS applications calculate the noise source on various platforms (Chucri A. Kardous, 2014), and several of them claimed to be precise in their application. Testing and measurement in a free field anechoic chamber can test their accuracy and compatibility with a different type of phone.

Noise reduction is currently assessed using large test benches, which consist of two side-by-side reverberation rooms with a minimum volume of 60m squared, separated by a wall in which

the test specimen should be positioned (Eng., National Research and Development Institute for Gas Turbine COMOTI, Romania). The research, verified NIOSH full anechoic chamber to create a free field environment and absorb all reverberant effects to become a new test bench. The validation method must be in tolerance with ISO 3745 and must have sufficient sound insulation for a low noise level. (Zufian and Lindawati, 2012).

A pilot study was done to assess the functionality and accuracy of smartphone sound measurement applications, investigate device hardware variability in measurement accuracy, and determine whether these applications can be relied upon to conduct participatory noise monitoring studies in the workplace.

ENVIRONMENTAL ERGONOMICS LABORATORY (EEL)

8

ENVIRONMENTAL ERGONOMICS LABORATORY (EEL)

Raemy Md. Zein, Ismail Abdul Rahman

8.1 INTRODUCTION TO ENVIRONMENTAL ERGONOMICS LABORATORY (EEL)

The environmental ergonomics laboratory (EEL) is one of the OSH Hazard Evaluation and Control Technology Centre that was established at Ergonomics Excellence Centre, NIOSH Southern Regional Offices, Johor Bahru. The establishment of this laboratory is to provide ergonomics environmental technical services and support as well as research and development activities in assessing and evaluating the environmental effect on humans toward the creation of a healthy and safe human-environment system. Evaluation and control based on new and more sophisticated criteria are required for the maintenance of indoor and outdoor safety and health from a human-focused viewpoint. EEL was capable to measure and testing environmental ergonomics factors related to:

- Thermal comfort analysis
- Simulation of the control environment and human performance in extreme environmental conditions
- Heat stress and heat strain testing
- Whole body and hand arms vibration
- Light intensity, luminance and visual comfort

Figure 8.0 Environment Ergonomics Laboratory (EEL)

8.2 LIST OF SCIENTIFIC EQUIPMENT

To accommodate such demand through the development and design of evaluation methods and control technologies, the facilities were equipped with sophisticated and up-to-date equipment. The available equipment consists of:

The environmental test chamber is a system that allows users to manipulate and simulate the environmental conditions of an enclosed space to run a controlled test on a subject. These 4 meters (width) x 4-meter (length) x 2.5 meters (height) chamber was used to reproduce one or a unique combination of weather environmental factor (-10 °C to 80 °C of temperature & 0% -100 % humidity level) to measure human psychophysiological response under different settings of temperature and humidity. This climatic chamber focuses on the effects of environmental stress on human physiology and performance.

Figure 8.1 EEL human climatic environmental chamber (outside)

Figure 8.2 EEL human climatic environmental chamber (inside)

1. *Heat stress monitor and air probe (WBGT)*

A WBGT device is a measurement tool that uses ambient temperature, relative humidity, wind and radiant heat to get a measure that can be used to monitor environmental conditions such as heat stress.

Figure 8.3 Heat stress monitor and air probe (WBGT)

2. Thermal Imager

A thermal imager is a non-contact temperature measurement device. It works by detecting and measuring infra-red radiation emitted, transmitted or reflected by all materials and objects.

Figure 8.4 Thermal Imager

3. Vapometer

The VapoMeter is the only fully portable instrument available for the measurement of transepidermal water loss (TEWL) values, evaporation rates and permeability measurement. TEWL is a key indicator of the skin barrier function and the ability to measure this accurately is essential in a wide range of care applications.

Figure 8.5 Vapometer

4. Human vibration meter (HVM)

HVM is a vibration measurement device for whole body vibration (WBV) measurement where the transmission is from the source through the feet or the buttock into the body and hand-arm vibration (HAV) measurement where transmission is through the hands and arms when using vibrating tools.

Figure 8.6 Human vibration meter (HVM)

5. Lux meter

Luxmeter or illuminance meter is a device that measures the number of lighting conditions in space or on a particular work surface. Lux meter measures both artificial and natural light and provides a quick and easy means of measuring lighting conditions in the workplace.

Figure 8.7 Lux meter

8.3 LABORATORY ACTIVITIES

This laboratory attempts to provide more services especially related to technical support and research & development activities to the stakeholders such as industry, government and educational institutes. A lot of activities and programmes were conducted by EEL especially related to the research and development, laboratory technical services through consultation and in-house testing, teaching laboratory and technical knowledge sharing.

Research and Development Activities (R&D)

Figure 8.8 Study on critical factors for heat stress and effects on humans' physiology in Malaysia.

NIOSH-UTM (2021-Present)

Figure 8.9 The study of heat stress and heat strain indices and their effects on worker's performance

NIOSH-UMK (2019-2020)

Figure 8.10 Study on health hazards exposure and control in industries

NIOSH (2017-2019)

Figure 8.11 Whole Body Vibration Exposure among Off-Road Lorry Drivers

NIOSH-UTHM

List of Publications:

1. Ismail, A. R., Jusoh, N., Makhtar, N. K., Zein, R. M., Rahman, I. A., Abdull Wahab, S. F., & Othman, R. (2021). Experimental study on human physiology during repetitive workload simulated under high temperature and high relative humidity. Journal of Physics: Conference Series, 1793(1). https://doi.org/10.1088/1742-6596/1793/1/012077

2. Ismail, A. R., Jusoh, N., Makhtar, N. K., Zein, R. M., Rahman, I. A., Che Hassan, N. H., & Mohamed, D. (2021). Experimental investigations and computational thermal simulation on human thermal comfort during performing office tasks. Journal of Physics: Conference Series, 1793(1). https://doi.org/10.1088/1742-6596/1793/1/012076

3. Ismail, A. R., Jusoh, N., Makhtar, N. K., Zein, R. M., Rahman, I. A., Khamis, N. K., & Mohamad, D. (2021). Implication of human skin temperature under high humidity to the construction workers' by using computational thermal simulation. Journal of Physics: Conference Series, 1793(1). https://doi.org/10.1088/1742-6596/1793/1/012075

4. Ismail, A. R., Jusoh, N., Zein, R. M., Rahman, I. A., Asri, M. A. M., & Makhtar, N. K. (2020). Application of computational fluid dynamic simulation for the study of heat stress and heat strain-A review. Journal of Advanced Research in Fluid Mechanics and Thermal Sciences, 73(2), 138–145. https://doi.org/10.37934/ARFMTS.73.2.138145

5. Rasdan Ismail, A., Jusoh, N., Amin Mahd Asri, M., Md Zein, R., Abdul Rahman, I., Kamilah Makhtar, N., & Mohamed, D. (2020). The factor affecting heat stress in industrial workers exposed to extreme heat: A case study of methodology. Journal of Physics: Conference Series, 1630(1). https://doi.org/10.1088/1742-6596/1630/1/012001

6. Fuad, A., Noor, M., Rahman, I. A., Yahya, M. N., Ghazali, M. I., Azali, N., Zein, R., Azis, N. A., Krishnan, H., & Selvan, T. (2016). Non- Loaded Lorry Based on ISO 2631-5 (2004). 11(10), 6450–6457.

7. Whole Body Vibration Study of Fully Loaded and Non- Loaded Lorry based on ISO 2631-5(2004)". Presented at 6th International Conference on Mechanical and Manufacturing Engineering. Published by ARPN Journal of Engineering and Applied Sciences Vol. 11, No. 10, May 2016.

8. The Whole-Body Vibration Exposure for off road Lorry Drivers: ISO 2631-1 (1997) and ISO 2631-5 (2004)". Presented at International Symposium on Advancements in Ergonomics and Safety and Lean Six Sigma Symposium 2015.

Laboratory technical services:

Figure 8.12 Thermal environmental assessment (Accredited testing: ISO 17025)

Figure 8.13 Thermal comfort testing

Figure 8.14 Whole body vibration and hand-arm vibration analysis

Figure 8.15 Workplace lighting assessment (Lux Monitoring)

Teaching laboratory

EEL also had been used as a teaching laboratory for NIOSH internal training as well as third parties training program such as higher education institutes. These laboratory classes provide participants and students with their first hands experience with the course concept and with an opportunity to explore methods used in environmental ergonomics.

Figure 8.16 Teaching Laboratory for NIOSH Internal Training:

- Initial Ergonomics Risk Assessment Training
- Advanced Ergonomics Risk Assessment Training
- Ergonomics and Manual Handling at workplaces
- Safety and Health Officer (SHO)
- Chemical Exposure Monitoring

Figure 8.17 Teaching Laboratory for external course

- Industrial Engineering Course for UTM student enrolled in Bachelor Degree of Mechanical-Industrial Engineering
- Experimental Laboratory for Postgraduate student, school of Mechanical Engineering, UTM
- Industrial internship laboratory for Industrial Engineering student from Universitas Sebelas Maret (UNS), Indonesia with collaboration from UTM (2018-2019)

Industrial visit

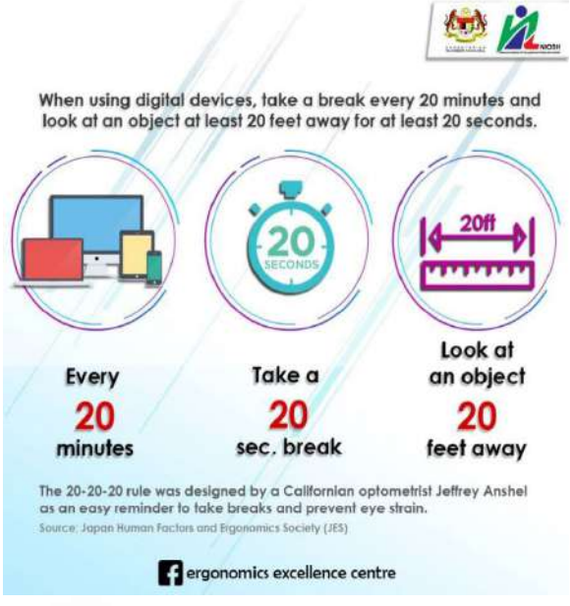

Figure 8.18 Industrial visit from Pusat Latihan Pertahanan Awam Wilayah Selatan (PULAPAS)


Figure 8.19 Visit from NIOSH chairman and Top Management


Figure 8.20 Visit from Human Factor and Ergonomics Society of Malaysia (HFEM)


Figure 8.21 Visit from Universiti Sains Malaysia (USM)

Figure 8.22 Knowledge sharing and information dissemination



8.4 LABORATORY TECHNICAL PERSONNEL

Laboratory Advisor
Raemy Md Zein

Technical Officer
Ismail Abdul Rahman

Lab Technician
Suhaimi Mohd Sukri

HUMAN ERGONOMICS ASSESSMENT LABORATORY
(HEAL)

9

HUMAN ERGONOMICS ASSESSMENT LABORATORY (HEAL)

Raemy Md.Zein, Noorul Azreen Azis

9.1 INTRODUCTION TO HUMAN ERGONOMICS ASSESSMENT LABORATORY (HEAL)

Overview

Malaysia is a growing country that is industrializing rapidly. Recent trends show that occupational-related injuries and non-communicable diseases, especially work-related musculoskeletal disorders, are increasing in various sectors. Various initiatives and strategies created by the authorities through the implementation of the Occupational Safety and Health Master Plan (OSHMP) have significantly improved the safety culture in Malaysia. It can be seen that health and safety policy is vital to increase organizational efficiency by reducing worker injuries, labor costs and lost time due to occupational accidents and diseases. In line with the national initiative, accurate and reliable data through research is necessary to improve occupational safety and health in the country. Therefore, NIOSH took a proactive approach by establishing an ergonomic laboratory, which focuses primarily on research and development activities related to human interaction with work stressors that are important in the field of ergonomics. The laboratory will also explore the interaction between work design and human needs to create comfortable, safe and healthy work environments.

Brief History

Human Ergonomics Assessment Laboratory (HEAL) was initially formed as an ergonomics laboratory under the Ergonomics Division, Consultation, Research & Development Department (CRDD), NIOSH. In January 2013, the division was renamed the Ergonomics Excellence Centre (EEC) and moved to its new location with all laboratory facilities at the main campus of the NIOSH Southern Regional Office in Johor. The leading manager of this newly established centre is Mr Raemy Md. Zein who is also formerly the manager leading the Ergonomics Division. In 2017, the Human Ergonomics Assessment Laboratory was established as part of the OSH Hazard Evaluation and Control Technology Centre (OSHECT). The development of HEAL was funded by a national grant under the Eleventh Malaysia Plan and equipped with various high-end scientific equipment.

Vision, Mission, Objectives

HEAL's goal is to be a focal reference point and centre of excellence in ergonomics services, research and development. In achieving our goal as a centre of excellence in ergonomics, all laboratory members are strongly inspired by NIOSH's Vision and Mission:

Our Vision:

To be a leading centre of excellence in Occupational Safety and Health in Malaysia.

Our Mission:

To provide practical solutions in the field of Occupational Safety and Health.

To achieve the above Vision and Mission, the laboratory has set the following objectives:

1. To provide an infrastructure for the human ergonomics reference and research centre at NIOSH;
2. To be a leader in research and development activities in the field of human ergonomics in Malaysia;

3. To offer, through its ergonomics excellence centre and other facilities, an unsurpassed range of opportunities to elevate necessary competencies practitioners in the various sub-disciplines of ergonomics through research and development and other NIOSH core services; and

4. To become a Centre of Excellence and reference in the field of ergonomics in Malaysia.

At the same time, the HEAL laboratory strives to meet the main objectives of establishing the OSHECT laboratory.

9.2 ORGANISATIONAL STRUCTURE

In 2013, the Ergonomics Excellence Centre started with four laboratories: OSH Science Laboratory, Workstation and Anthropometric Laboratory, Lighting Laboratory and Biomechanics Laboratory. Later, two laboratories were upgraded into the Human Ergonomics Assessment Laboratory (HEAL), which was established under the Eleventh Malaysia Plan 2016-2020, funded by the Ministry of Human Resources in 2016, to establish integrated OSH laboratories in NIOSH Malaysia in anticipation of the increasing challenge and complexity of human ergonomics issues in workplaces. Over the years, ergonomic laboratories have assumed increasing responsibilities, especially in consultation, ergonomics research and development and rendering services to the industries and the public. The laboratory management system comprises two parts, namely the management and the technical teams: the management team is led by the Management Representative (MR), and the technical team is led by Laboratory Advisor (LA).

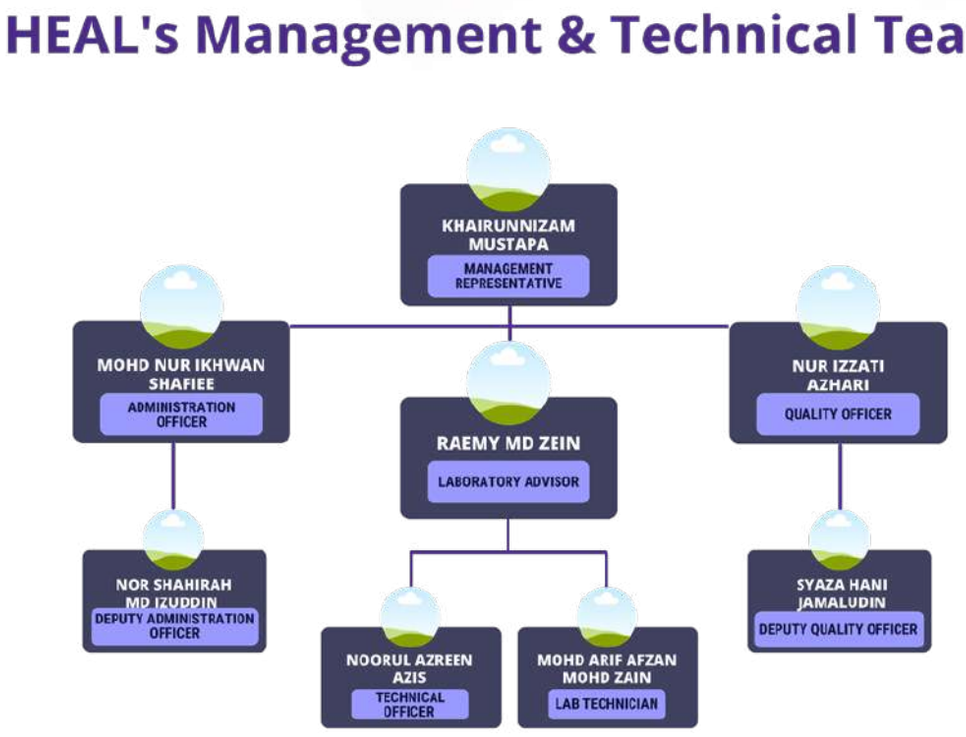


Figure 9.0 Heal's organisational structure

Staffing and Field Of Expertise

Currently, the laboratory has one laboratory advisor, one technical officer and one laboratory technician. In line with the need for a holistic and integrated approach to solving the many workstation designs and human ergonomics problems, the laboratory collaborates with various experts from different backgrounds related to engineering, occupational health, industrial ergonomics and design through the Smart Partnership programs within our Research and Development Programs. The main directions are ergonomics mini-research, industrial research collaboration through NIOSH R&D grants, industrial ergonomics risk assessment, anthropometric studies, and workstation design appraisal.

Mr Raemy Md Zein is a Technical Expert cum Principal Consultant at NIOSH and Laboratory Advisor for the Human Ergonomics Assessment Laboratory with twenty-two years of experience in the ergonomics fields. Mr Raemy specialises in physiology, environmental and industrial ergonomics. He is responsible for educating and advising industries on using ergonomics management systems and applications thru consultation, research & development and seminars. Mr Raemy has been actively involved in the various technical committee for ergonomics guidelines and standards development. Other than that, he is also actively involved in multiple research and consultations project:

Ergonomics Risk Assessment (ERA):

- ✓ Central Sugars Refinery Sdn Bhd
- ✓ KL Convention Centre
- ✓ Lafarge Asia Sdn Bhd
- ✓ Technip Asiaflex (M) Sdn Bhd
- ✓ Halliburton Manufacturing & Technology (M) Sdn Bhd

Medical Surveillance and Fitness Assessment:

- ✓ Petronas Dagangan Berhad
- ✓ Maybank Berhad
- ✓ International Islamic University Malaysia

Ergonomics Management Programme Development:

- ✓ Samsung Electronics Malaysia Sdn Bhd
- ✓ UMW Toyota Motors (M) Sdn Bhd
- ✓ Pharmaniaga Berhad

For a detailed bibliography, visit the ***List of Experts*** on the NIOSH Malaysia website.

Mr Noorul Azreen bin Azis is an ergonomics enthusiast and Executive cum Technical Officer at Human Ergonomics Assessment Laboratory (HEAL), Ergonomics Excellence Centre (EEC), NIOSH Southern Regional Office (Johor). Interest in statistics, research on physical ergonomics, biomechanics and cognitive ergonomics. He graduated from Universiti Teknologi Malaysia (UTM) with a degree in Biological Science and a Master's degree in Safety, Health & Environment. Mr Azreen is actively involved in various ergonomics consultation and R&D projects; such as:

Ergonomics Risk Assessment (ERA):

- ✓ Asian Innovation Centre
- ✓ Malayan Banking Berhad
- ✓ Taiyo Yuden Sarawak Sdn Bhd

Ergonomics Product Verification Assessment (EPV):

- ✓ TNB Research Sdn Bhd
- ✓ Telekom Malaysia Berhad
- ✓ Dellner Bubenzer Malaysia Sdn Bhd

Postural & Manual Handling Assessment:

- ✓ Synthomer Malaysia Sdn Bhd
- ✓ Revertex Malaysia Sdn Bhd
- ✓ HGST Malaysia Sdn Bhd

Research & Development (R&D):

- ✓ Study on Health Hazard Exposures and Controls in Industry
- ✓ Study on Ergonomics Intervention Control for Manual Material Handling in Manufacturing Sector.

Mr Mohd Arif Afzan bin Mohd Zain is a Technician at Human Ergonomics Assessment Laboratory, Ergonomics Excellence Centre (EEC) NIOSH. Mr Arif specialises in Industrial Ergonomics Designs and has been registered as a Graduate Engineer with the Board of Engineer Malaysia (BEM) and as Ergonomics Trained Person (Initial ERA) with DOSH. He graduated from Universiti Tun Hussein Onn Malaysia (UTHM) with a Bachelor of Mechanical Engineering. Among the projects and studies he has been and is currently involved in are;

Ergonomics Risk Assessment (ERA):

- ✓ Central Sugars Refinery Sdn Bhd

- ✓ Synthomer Sdn Bhd
- ✓ CEFS Response
- ✓ Corelle Brands Manufacturing (M) Sdn Bhd

Ergonomics Products Verification Assessment (EPV):

- ✓ Dellner Bubenzer Malaysia Sdn Bhd
- ✓ Telekom Malaysia Berhad
- ✓ TNB Research Sdn Bhd

Office and Lighting Assessment:

- ✓ Pustaka Negeri Sarawak

Research & Development (R&D):

- ✓ Study on Ergonomics Intervention Control for Manual Material Handling in Manufacturing Sector.
- ✓ Development of a Survey Instrument for Measuring Workers Satisfaction on Usability of Manual Handling Equipment at the Warehouse: A Pilot Study
- ✓ Innovation & Commercialization (I&C) Projects - PROJEK Ergo-SEHAT
- ✓ Study on Development of Mechanism to Control and Prevent Pandemic Through Development of Health Risk Matrix in Various Industry

9.3 FACILITY AND LABORATORY DEVELOPMENT

Development of the HEAL laboratory started in June 2017 until December 2017. The two laboratories, namely the OSH Science laboratory and the Lighting Laboratory, have been renovated into new laboratories with new scientific equipment. The newly renovated laboratory is equipped with a range of advanced scientific equipment specifically for research and development related to human ergonomics assessment, performance analysis, motion analysis and predictive analytics software

Figure 9.1 Scientific equipment and facilities available in the laboratory specifically for human ergonomics research and assessment

Figure 9.2 Portable data acquisition system and software used in biomechanics and performance assessment

9.4 LAB ACTIVITIES AND SERVICES PROVIDED

Technical Services

HEAL has made significant contributions to the industry and community by providing a wide range of technical service activities since its inception in 2017, primarily through ergonomic risk assessment and ergonomics product verification.

Figure 9.3 Ergonomics Technical Services provided by the laboratory

The lumbar Spine Motion Monitoring test is the earliest technical service provided by HEAL. This assessment aims to assess the risk related to workplace manual material handling activities. The low back disorder risk model is used to identify the average probability of low back disorder risk and identify which element in manual handling activity job led to injury and needs intervention.

Figure 9.4 The application of the lumbar motion monitoring test in the industrial setting

Another technical service provided is the Functional Capacity Evaluation Test. An employee's ability to carry out duties associated with his employment is evaluated by a functional capacity evaluation (FCE). The FCE technique compares a person's health, physical body function, and work tasks to the requirements of their profession and working environment. An FCE's main objective is to evaluate a person's ability to engage in the workforce. This extensive test technique was assessed using JTech Medical equipment that was on hand in the HEAL laboratory.

Figure 9.5 Examples of the test methods in the human functional capacity evaluation

Research and Development

During 2017-2019, HEAL laboratory was involved in the success of studies funded under the Eleventh Malaysia Plan, which related to the study on Health Hazard Exposure and Controls in Industries. The study focuses on ten subsectors: furniture, metal, plastics, electronic, municipal authority, sanitary and health services, industrial water facility, wholesale, engineering works and construction, and agriculture industry. Research and development activities also involve higher learning institutes and other agencies. Through the Smart Partnership Program, the laboratory facilities and equipment are used by students to conduct research activities related to ergonomics and design. The HEAL laboratory has collaborated successfully with five universities through a research and development programme.

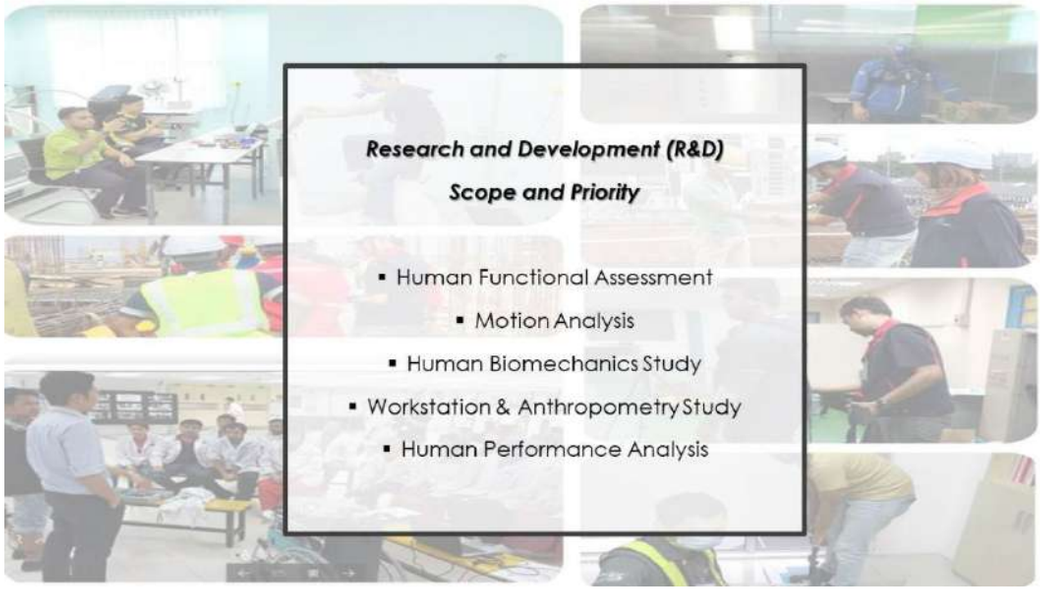


Figure 9.6 Study scopes and research & development priority area at the human ergonomics assessment laboratory

Figure 9.7 List the research and development projects conducted using facilities and expertise from HEAL with the engagement of various industrial and university players.

Biomechanics, Electromyography and Motion Analysis

The study of continuum mechanics, or the study of loads, motion, stress, and strain of solids and fluids, as they apply to biological systems, is known as biomechanics. It also refers to the mechanical influences on the human body's size, form, and structure. In contrast, human motion analysis is the methodical examination of human motion by close observation and using equipment to record body motions, body mechanics, and muscle activation. Its goal is to compile numerical data regarding the mechanics of the musculoskeletal system when a motor task is carried out. In the musculoskeletal system, which is controlled by the neurological system, the mechanical interaction of bones, muscles, ligaments, and joints results in human movement. The HEAL laboratory was equipped with 3D motion sensors and wireless pressure distribution sensors utilised for this study. The study aims to identify body movement and musculoskeletal activity to remove discomfort and pressure on the bones, joints, muscles and ligaments. This research will provide intervention strategies to improve workers' performance, reduce injuries and heighten general wellbeing

Figure 9.8 Optical motion capture systems have become increasingly widespread in human factors & ergonomics, biomechanics and sports science studies.

Figure 9.9 The application of 3D motion sensors provides ergonomics researchers and biomechanists with ideal 3D tracking data for ergonomics research and development studies

Workstation & Anthropometric Study

Ergonomics is a work science that considers human interaction with work systems and the environment covering the way work is done, selection of equipment, workstation design and requirements, environmental stressors and psychosocial aspects while working. All the interactions mentioned are intended to ensure that humans can work safely and in healthy conditions. Comfort is also one of the criteria taken into consideration in the ergonomic aspect. Applying anthropometric measurements is one of the practical approaches to ensure that workstation design, tools and instruments are designed to fit the human body and meet the human capability. At HEAL, the anthropometric databases were measured using NIOSH Anthropometric Grid, which NIOSH Researcher designed.

Figure 9.10 Anthropometric measurements and databases are vital components in human-centered design, supporting prevention through ergonomics design approaches

9.5 PHOTO GALLERY

Facility Available in the laboratory

Figure 9.11 Spiroergometry and ergometer systems for evaluation of human metabolic system while under physical stress

Figure 9.12 3D Motion Capture system for gait and motion studies

Figure 9.13 A medical treadmill and ergometer simulate the physical activities for cardiopulmonary and performance metabolic tests

Research & Development activities

Figure 9.14 Cardiopulmonary exercise and metabolic performance testing using a face mask wirelessly connected to the spiroergometry system

Figure 9.15 Simulation study was conducted to evaluate the body's response to extreme temperature while performing the work task

Figure 9.16 The measurement of brain activity using a portable electroencephalogram (EEG)

Figure 9.17 The study on the effect of seat design on body pressure distribution measurement by postgraduate student

Figure 9.18 The measurement of brain activity using a portable electroencephalogram (EEG) for sedentary worker

Figure 9.19 The measurement of near point of convergence (NPC) for the diagnosis and management of convergence insufficiency

Figure 9.20 Cardiopulmonary testing and gait analysis for walk-test simulation

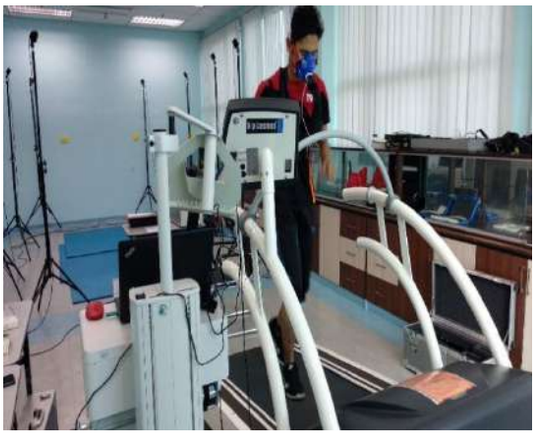


Figure 9.21 Cardiopulmonary testing for functional assessment under different training intensity

Figure 9.22 Equipment familiarisation and hands-on training sessions for final year undergraduate students related to body pressure distribution measurements

Figure 9.23 Equipment familiarisation and hands-on training sessions for final year undergraduate students related to manual handling and work posture

Figure 9.24 The training session is one of the proactive approaches to optimise the usability of the laboratory and equipment under the Smart Research Partnership Program

Figure 9.25 Inv olveme nt of uni versities students in ergonomics research conducted using HEAL facility

Figure 9.26 Muscle activity measurement and fatigue assessment using electromyogram (EMG) device

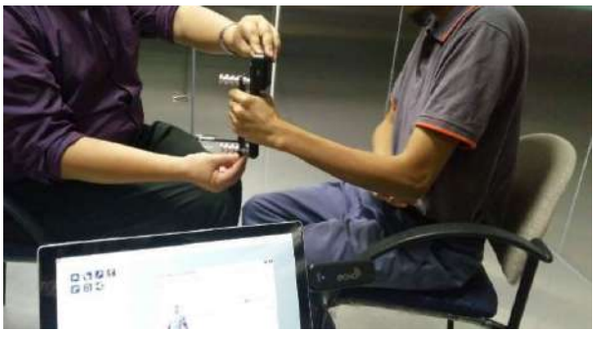


Figure 9.27 Hand grip strength test to measure the maximum isometric strength of the hand and forearm muscles

Figure 9.28 Muscle testing analysis to evaluate muscle impairment or strength deficit by nerve root or peripheral nerve using dynamometer muscle testing gauge

Figure 9.29 Pinch testing for hand therapy, upper extremity injuries and strength evaluations

Technical Service Activities

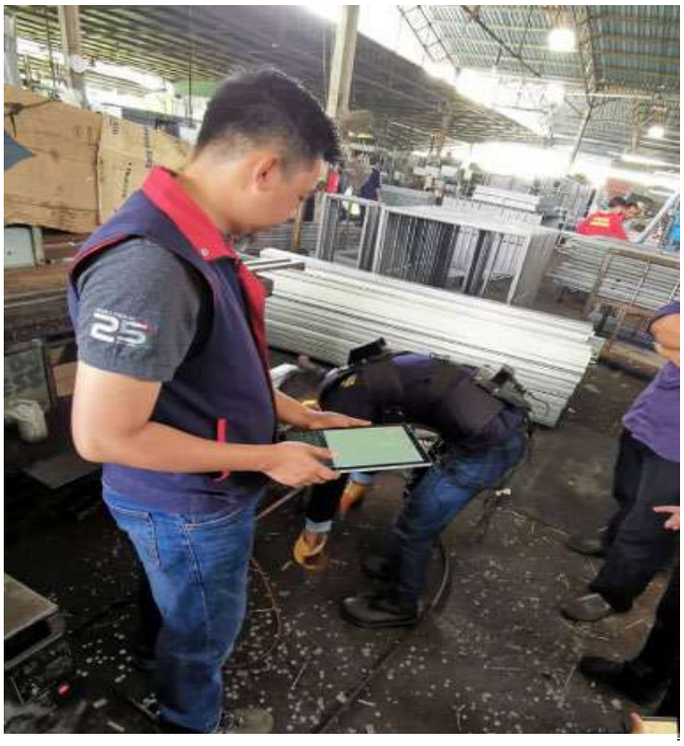


Figure 9.30 Lumbar spine motion monitoring test during ergonomics intervention assessment to improve work system

Figure 9.31 Measurement of muscle activity and muscle fatigue based on the real working situation using a portable electromyogram system among cockles harvester

Figure 9.32 An interpersonal study and familiarisation training among lab technicians to ensure reliability and internal competency among staff

Figure 9.33 The measurement of muscle activity and muscle activation profile during gripping exercise

Figure 9.34 Measurement of low back disorder risk among cable jointer

Teaching Lab Activities

Figure 9.35 Training on anthropometric data collection for sitting posture

Figure 9.36 Training on anthropometric data collection for standing posture

Figure 9.37 Consultation activity and technical lab services briefing session

Figure 9.38 The utilisation of laboratory facilities for teaching activities related to

Figure 9.39 Visitation from NIOSH Top Management to HEAL facilities

Figure 9.40 A coaching session for every utilisation of scientific equipment at laboratory

Figure 9.41 The students must demonstrate and explain all the information given during training to measure the level of understanding and ensure all scientific equipment is appropriately handled

Figure 9.42 Lab familiarisation training under the Smart Research Partnership program for final year undergraduate students involved in ergonomics research

Information dissemination activities

Figure 9.43 Lab personnel involvement in information dissemination activity

Figure 9.44 The participant participated in a simulated Functional Capacity Evaluation assessment

Figure 9.45 Real-time functional assessment test on static strength to determine subject's physical capacities

9.6 LAB ACHIEVEMENT

Accredited Laboratory ISO/IEC 17025:2017

A quality management system called ISO/IEC 17025 is the industrial practices standard for any organisation that requires accurate testing and calibration findings. To receive ISO/IEC 17025 accreditation, a laboratory must pass an assessment of its technical proficiency and quality management system by an authorised accrediting organisation. A laboratory's ability to provide testing and calibration results and its quality management system is verified through this certification. Many organisations and agencies accept the findings of testing and calibration processes by certified laboratories following international standards. A globally recognised standard called ISO/IEC 17025 certifies that a participating laboratory satisfies the demands of clients for reliable data. In 2022, the Human Ergonomics Assessment Laboratory received ISO/IEC 17025 certification to perform Lumbar Spine Motion Monitoring Tests in working settings. The accreditation attests to the laboratory's capability to measure the spine's movement based on angular positioning, speed, and acceleration in three positions: sagittal, lateral, and twisting planes. The Low Back Disorders Risk Model was used to evaluate the data and forecast the average probability of low back disorders (LBD) risk resulting from manual handling activities at the workplace. This accreditation also acknowledges the technical team of the HEAL laboratory and their in-depth technical expertise.

Test Method

The Lumbar Spine Motion Monitoring Test is an accredited test procedure under ISO/IEC 17025. This test uses wireless 3D motion tracking technology to monitor lumbar spine movement in several angular positioning. This analysis intends to evaluate the risk associated with manual material handling activity. Findings from the lumbar spine motion monitoring evaluation were then used to pinpoint the aspects of manual handling tasks that increased the risk of back pain and provide ideas for effective intervention strategies. Even though the manual handling risk cannot be eliminated, by measuring risk levels, the model can assist occupational health practitioners, especially ergonomists, in determining if a manual handling task is within acceptable risk bounds. Furthermore, it can offer a "benchmark" of low back disorder risk for specific work tasks, enabling comparisons between the original design and potential job rotation or intervention.

Schedule

Issue date: 1 March 2022
Valid until: 21 January 2024

STANDARDS MALAYSIA ACCREDITED

NO: SAMM 412
(Issue 2, 1 March 2022 replacement of SAMM 412 dated 16 April 2021)

SCOPE OF TESTING: MECHANICAL

Materials/ Products Tested	Type of Test/ Properties Measured/ Range of Measurement	Standard Test Methods/ Equipment/Techniques
Lumbar Spine Motion Monitoring	Measure position, velocity and acceleration of the human spine movements, in the sagittal, lateral and twisting planes	In-house based on Operator's Manual for Acupath Lumbar Motion Monitor with Ballet 3.1 Software

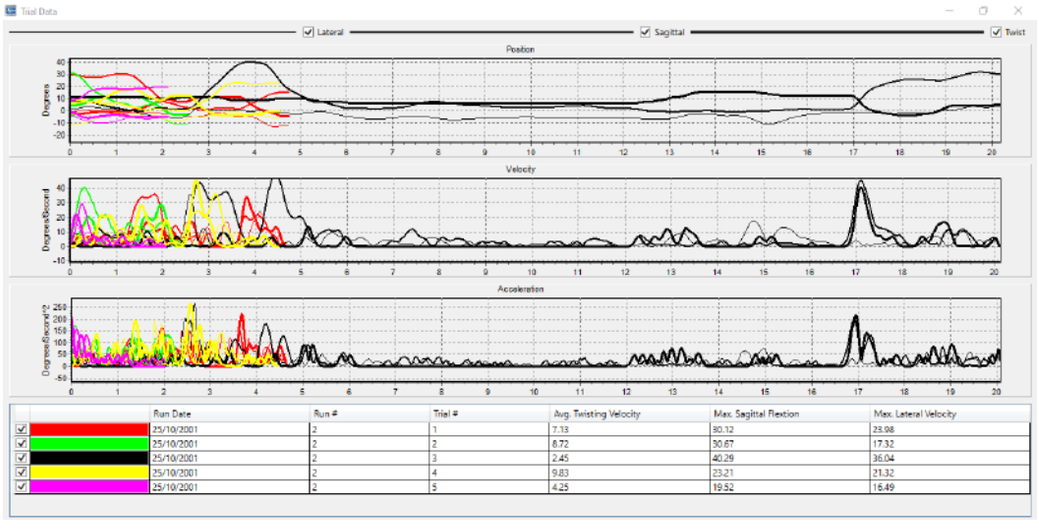
Signatories:

1. **Noorul Azreen Azis**
2. **Ismail Abdul Rahman**

Figure 9.46 Accredited scope under ISO/IEC 17025:2017 for Human Ergonomics Assessment Laboratory (sources: Department of Standards Malaysia)

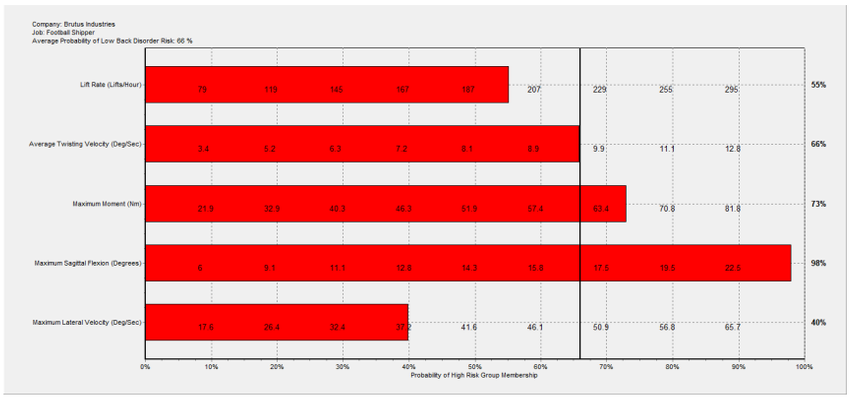
Figure 9.47 The lumbar spine motion monitoring was utilised to measure the effectiveness level of ergonomics control practised within industries

Figure 9.48 The industrial lumbar motion monitor measured the lumbar movement in three angular positionings



	Run Date	Run #	Trial #	Avg. Twisting Velocity	Max. Sagittal Flexion	Max. Lateral Velocity
☑	25/10/2001	2	1	7.13	30.12	28.98
☑	25/10/2001	2	2	8.72	30.67	17.32
☑	25/10/2001	2	3	2.45	40.29	36.04
☑	25/10/2001	2	4	9.83	23.21	21.32
☑	25/10/2001	2	5	4.25	19.52	16.49

Graph 1.0 Viewing trunk kinematic data during manual handling activity



Graph 2.0 Low Back Disorder (LBD) Risk model analysis bar chart

PPE SIMULATION LABORATORY
(PSL)

10

PPE SIMULATION LABORATORY (PSL)

Yuzainie Bin Yusof, Syaza Hani Jamaluddin

10.1 INTRODUCTION TO PPE SIMULATION LABORATORY (PSL)

PPE Simulation Lab (PSL) is included in the First Rolling Plan (RP1) which is one of the high-tech laboratories that was developed in 2017. The PSL laboratory was developed with a financial allocation of RM 1 million. The completion period of this laboratory is for 1 year. PSL is located at level 2 *Bangunan Utama* NIOSH.

There are three objectives for the establishment of PSL:

a) to provide interactive training methods with a combination of the latest IT systems

b) to develop new OSH training modules with the use of OSHECT facilities

c) to carry out R&D projects with the support of OSHECT services

PSL is a teaching laboratory that uses Augmented Reality (AR) which allows interaction with holograms in the real world. The system embedded into the device is called NIOSH Augmented Reality Simulation of Safety and Health Training (NART). It provides benefits such as improved safety, efficiency, communication, and collaboration. The NART system is a simulation training system that trains managers, supervisors, and workers to understand their responsibilities and the necessary actions to be taken toward upgrading safety and health at their respective workplaces, working of safety management systems and legal compliance required.

In 2018 PSL offered Interactive Training Series of modules which are Laboratory Safety, Working at Height, and Confined Space. Throughout the development of PSL, PSL has been visited by local and private universities, government agencies, and organizations. Other than teaching laboratory, PSL is also keen on any research collaboration needs toward IR 4.0.

Table 4.0 NART modules

MODULE NAME	SECTOR NAME	SCENARIO	LIST OF ACTIVITIES	TYPE
Module 1 **Working in Confined Space**	Oil & Gas	Oil Gas Platform	• Welding • Grinding	Procedure Base
Module 2 **Working at Height**	Construction	Warehouse	• Painting	Procedure Base
Module 3 **Working in Laboratory**	Manufacturing	Laboratory	• Chemical Spillage Cleaning	Emergency Base

Figure 10.0 Working in Laboratory

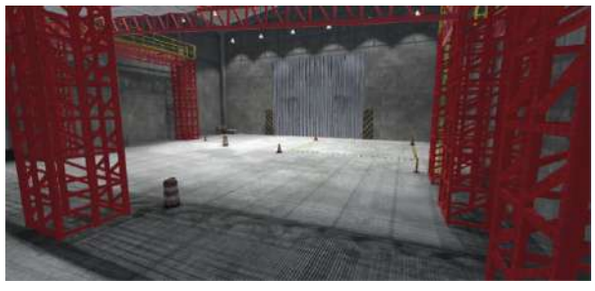


Figure 10.1 Working at Height

Figure 10.2 Working in Confined Space

Modules footage

What is the difference between AR, VR, and MR? Augmented Reality (AR) adds digital elements to a live view, often using the camera on a smartphone. Examples of augmented reality include the Pokemon Go game apps. However, Virtual Reality (VR) implies a complete immersion experience that shuts out the physical world. Using VR devices, users can be transported into several real-world and imagined environments. In a mixed reality (MR) experience, which combines elements of both AR and VR, real-world and digital objects interact. Mixed reality (MR) technology is just now starting to take off with Microsoft's HoloLens, one of the most notable early mixed reality apparatuses.

Throughout 2019, PSL has been visited by many visitors, including the Government of Guyana. PSL is open for any visitors to come and share knowledge. If you want to experience a mixed reality experience, come and visit us at PSL Level 2 *Bangunan Utama* NIOSH Bandar Baru Bangi.

Figure 10.3 Hololens device

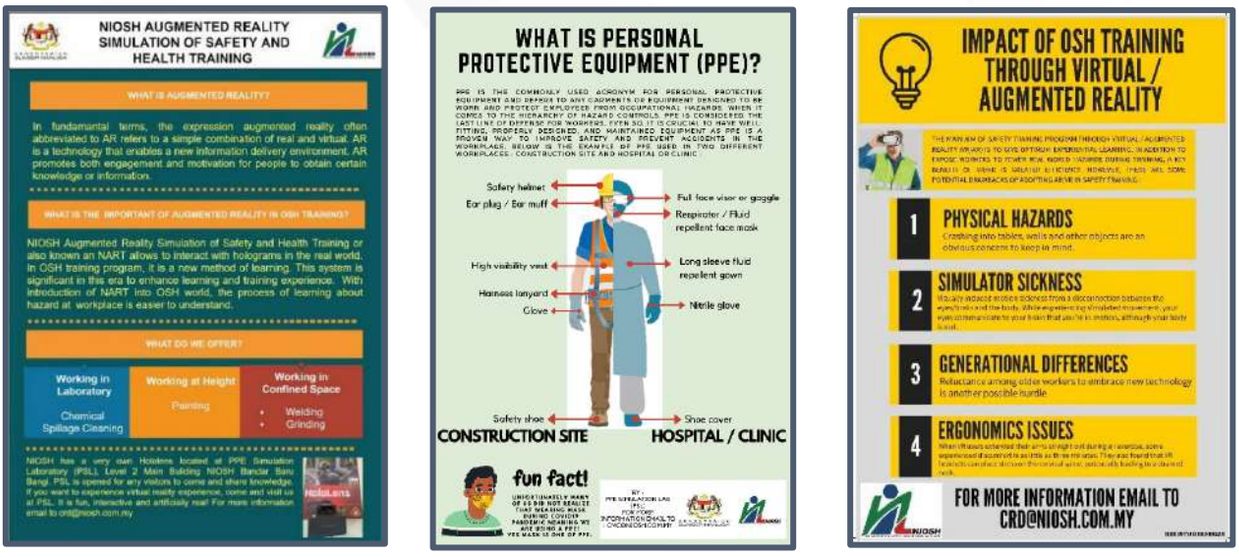


Figure 10.4 Infographics

10.2 PSL's ACTIVITIES

Figure 10.5 Exhibition at Cenviro Sdn Bhd

Figure 10.6 Lab visit from Universiti Teknologi Petronas (UTP)

Figure 10.7 Lab visit from Makmal Keselamatan dan Kualiti Makanan (MKKM)

Figure 10.8 Lab visit from Serba Dinamik Group Sdn Bhd

Figure 10.9 Lab visit from Universiti Pendidikan Sultan Idris (UPSI)

Figure 10.10 Exhibition during Air Selangor HSE week


SCAN HERE FOR PPE
SIMULATION LAB VIDEO
YouTube

GAS DETECTOR CALIBRATION LABORATORY (GCL)

11

GAS DETECTOR CALIBRATION LABORATORY (GCL)

Ts. Haji Mohd Esa Bin Haji Baruji, Mohd Fikri Hakim Bin Abdullah, Muhammad Akmal Bin Muzhafar Azman Wong & Muzhafar Bin Ibrahim

11.1 INTRODUCTION TO GAS DETECTOR CALIBRATION LABORATORY (GCL)

Background

There are a few terms used in the occupation for gas detectors such as gas detection instrument/ equipment, gas indicator, or atmosphere testing and monitoring equipment. Gas can be defined as a state of matter characterised by very low density and viscosity (relative to liquids and solids), comparatively great expansion and contraction with changes in pressure and temperature, ability to diffuse readily into other gases, and ability to occupy with almost complete uniformity the whole of any container (Gas Detection Handbook, 2007). Meanwhile, a gas detection instrument or gas detector is defined as a device composed of electrical, optical, mechanical, or chemical components that sense and respond to the presence of gas mixtures. Whereas, calibration is a procedure by which the performance of a detector is verified to maximise the accuracy of its readings. Calibration is performed by: (1) comparing the instrument with a known standard, and (2) adjusting the instrument reading to match the standard. Therefore, in short, gas detector calibration refers to an instrument's measuring accuracy relative to a known traceable concentration of test gas. The detector compares the sensor's response to a known concentration of test gas. Calibration ensures the gas detector works accurately.

A gas detector can be used to detect combustible or flammable or explosive gas, toxic or noxious or irritant gas and oxygen gas. Common gases that are detected and calibrated are Carbon dioxide (CO_2), Oxygen (O_2), Methane (CH_4) or explosive gas (LEL), Hydrogen

sulphide (H_2S) and Carbon monoxide (CO). They are commonly used in the Marine, Oil and Gas, Pharmaceutical, Process Industry, Petrochemical and sewerage industries.

Many lives have been lost throughout the world by confined space-related accidents. Most of the victims were either overcome by toxic fumes or died from gas explosions. The incidents generally reveal a marked lack of safety measures and complete disregard for occupational safety and health (OSH) legislation by employers and workers themselves. Most, however, can be brought down to lack of training, incompetence by supervisory management, cost cutting with personnel cutting corners to get the job done on time and within budget and a total lack of understanding that **GAS CAN KILL**! (Safe Working in Confined Spaces Edition 2, 2006).

In 2005, under the JICA-NIOSH building capacity project, NIOSH sent one of the staff to gain experience and knowledge about gas detectors at few related government's agency and education institution at Tokyo & Fukuoka, Japan. Mr. Hj. Mohd. Esa bin Hj. Baruji, the acting manager of OSD was selected by the NIOSH management to be there for the purpose. He is one of the pioneer trainers and module developers for the confined space programme not only in NIOSH but in Malaysia. NIOSH also sent 2 officers (Mr. Hj. Mohd. Esa and Mr. Mohd Nazif bin Mohd. Zaidan) to Drager Headquarter (R&D and Production) at Lubeck, Germany for familiarisation with gas detector production and technical information at 2008. The program was accompanied by one of the Drager Malaysia Sdn Bhd's staff (Subang, Selangor), Mr Robert Loh (Rtd). The program focuses on the inside of gas detector construction, structure, installation and commissioning. The training was delivered by the pioneer and technical expert of Drager Headquarters. As an international leader in safety technology, Dräger develops innovative equipment and solutions trusted by people all over the world. No matter where Dräger products are used: it's always about life. Whether for use in industrial, clinical, or mining applications, in firefighting or rescue services, Dräger products protect, support and save lives. The slogan of "Technology for Life" means more than merely guaranteeing technical excellence. It means assuming responsibility for the lives of those who use the products and depend on them. Technology for Life is the guiding principle and the central

challenge that draws on inspiration and motivation. GCL chose Dräger as benchmark because of its corporate culture and core capabilities, which include customer involvement, staff engagement, innovation, and quality.

Figure 11.0 In Front of Dräger Germany

Figure 11.1 Technical Familiarities Training

Figure 11.2 Sharing Session with Drager's Technical Expert (Officer Room)

Figure 11.3 Training Session with Drager's Technical Expert (Meeting Room)

Our Journey

Initially, NIOSH Gas Detector Calibration Laboratory (GCL) was established under the Industrial Hygiene Analytical Laboratory (IHAL) in 2009 by using NIOSH financial allocation. The earlier team for GCL was:

Figure 11.4 GCL Organisation Chart (2009)

The idea to develop the GCL emerged after NIOSH identified a demand from the industries related to the calibration of gas detectors while conducting classes and activities related to confined space programmes namely Authorised Entrant & Standby Person for Confined Space and Authorised Gas Tester & Entry Supervisor for Confined Space. GCL's mission is to assist industries in complying with the Industry Code of Practice for Safe Working in a Confined Space (ICOP CS) 2010, Occupational Safety and Health Act (OSHA) 1994 and Factories and Machinery (Safety, Health and Welfare) Regulations 1970. For example, under the requirement to ensure safety in an atmosphere of ICOP CS 2010, it is essential to ensure that the gas detector used at the workplace is calibrated as in clause 8.6.5(b).

Meanwhile, since NIOSH also uses gas detectors for training, research, consultation and exhibition activity for the whole country (with 6 regional offices comprising more than 10 site offices), there are more than 150 gas detectors that need to be calibrated timely and properly as a leading example to the industry. By having this laboratory, it will save thousands of ringgit on calibration requirements indirectly. In addition, this laboratory also becomes the hands-on venue for confined space program participants' experiential learning to enhance the understanding of gas detector calibration as well as maintenance purposes. The laboratory is also open for external visits and collaboration. On average, a total of 50 visitors visited the laboratory yearly for many purposes.

Figure 11.5 Function of GCL NIOSH

1. In 2011, GCL moved under the Occupational Safety Division (OSD),CRDD, and NIOSH with manual and procedures still under Industrial Hygiene Analytical Lab (IHAL) documentation. OSD was established to lead consultancy activities related to occupational safety, for instance, Confined Space Risk Assessment (CSRA),

audit, and inspection. NIOSH's GCL indirectly expands laboratory functions by involving CSRA activities and offer for gas testing as well as monitoring in external operations. The establishment of this laboratory has also made GCL a reference laboratory in the study of confined space and gas detector calibration. Another milestone is when GCL was accredited with Skim Akreditasi Makmal Malaysia (SAMM) by the Department of Standards, Malaysia based on ISO/IEC 17025 under the field of Electrical Testing in 2016.

There were 2 residents approved signatories accredited under the scheme which are

1. Mr. Mohd. Esa bin Baruji and
2. Mr. Muhammad Akmal bin Muzhaffar Azman Wong

Figure 11.6 Gas Detector Calibration Laboratory (GCL)

In 2018, CRDD decided all OSH laboratories were placed under OSH Hazard Evaluation and Control Technology Centre (OSHECT), including GCL. In fulfilling the aspiration to be a leading centre of excellence in OSH, GCL also embarking on-site calibration for portable gas detectors in the year 2022 (ongoing for SAMM accreditation extension of scope endorsement). In addition to present approved signatories, Mr. Mohd Fikri bin Hakim Abdullah was proposed to be the on-site calibration approved signatory.

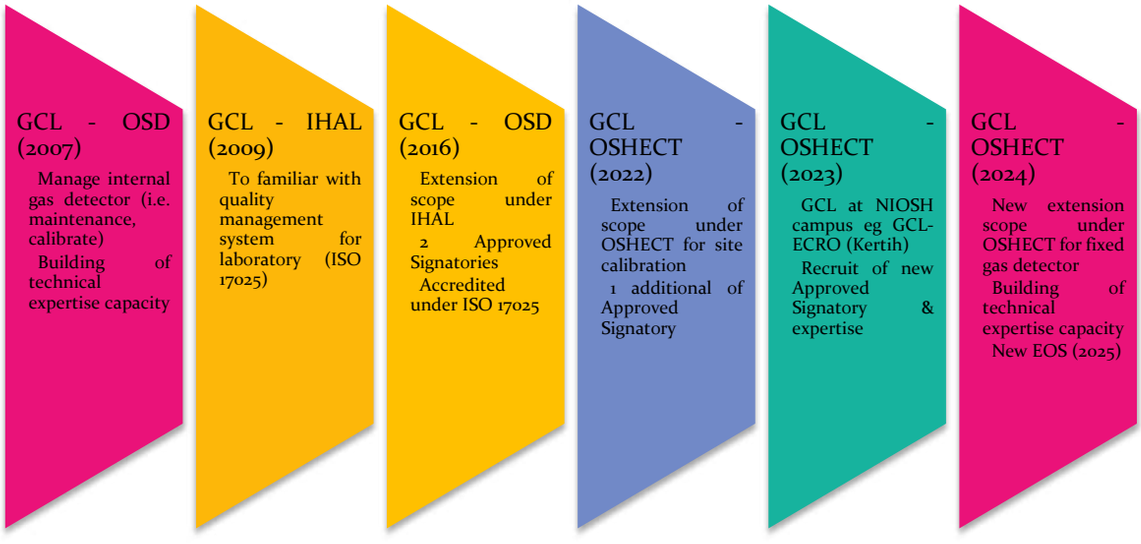


Figure 11.7 Development of GCL in NIOSH from 2009 to 2025 (Planning)

To date, since 2016, more than 250 units of portable gas detectors were successfully calibrated, comprising more than 10 different models. Currently, GCL is capable of calibrating detectors with a sensor such as Methane, Oxygen, Carbon monoxide, Hydrogen sulphide, Carbon dioxide, Chlorine (Cl_2), and Ammonia (NH_3) and volatile organic compound (VOC). GCL also provides advisory services concerning the proper usage, maintenance and storage of the gas detector. GCL is committed to finding opportunities in developing this laboratory in the future as summarised in Figure 11.8 including as a way forward. GCL hopes to provide the best and quality service to our customers and it is our responsibility to maintain the satisfaction of our customers.

GCL Team

Laboratory Advisor (LA)

Ts. Hj. Mohd. Esa is currently as Principal Consultant/ Principal Researcher at CRDD, NIOSH Malaysia since 2018. In 1997, he was awarded the Bachelor of Engineering in Electronics from the University of Manchester Institute Science & Technology (UMIST), Manchester, United Kingdom. He pursued his Master in Industrial Safety Management from the National University of Malaysia on 2003. He is registered:

1) Industrial Researcher in MyGRANTS, Ministry of Higher Education (Registration No.: 88067);
2) Assessment Panel for OSH Program – Malaysia Qualifications Agency (MQA)(APP MQA No.: 2252);
3) Ex-Officio of NIOSH to Malaysian Society for Occupational Safety and Health (MSOSH) (Membership No.: 1184); and
4) Professional Technologist in Manufacturing and Industrial Technology (ME) field (Certificate No.: PT20110256).

With nearly 25 years of working experience in industry and institute, his patience with OSH is endless and makes him inspired to become an expert in the OSH field. In the consultation area, he specialized in

1) OSH legislation compliance (e.g. process safety management, confined space risk assessment), 2) OSH solution (e.g. development of HIRARC, risk management, safety inspection, audit, OSH management system), 3) OSH advisory (e.g. customized/ in-house training development such as Electrical Safety, Lock Out Tag Out Test Out [LOTOTO], Permit To Work [PTW], OSH Induction), and 4) Laboratory service (e.g. advisor, laboratory management representative, approved signatory, equipment calibration, testing and industrial hygiene analytical process).

He was also involved in more than 11 OSH research projects as head project and researcher amounted value of up to more than RM7 million. He already presented and published his research findings as well as written books at the national and international seminar/ conference levels.

In contributions to the nation as a central committee in OSHMP2025, NCOSH, HRD Corp, NSC W, OSH Lead auditor/ panel, trainer, assessor, examiner, approved signatory, guideline & laboratory advisor, journal editorial board & review panel, expert review, panel judge, prominent writer & author, lecturer, competent person (confined space & scaffolder), he was also involved in technical committee, working group and ex-officio in formulating the Malaysian Standards, Industry Code of Practices and Guidelines and National Occupational Skills Standard (NOSS) with :National Council of OSH (NCOSH), DOSH, Department of Skills Development (DSD), Ministry of Human Resources, SIRIM, Department of Standards Malaysia (DSM), Ministry of International Trade and Industry, CIDB, Ministry of Works, and MSOSH. He had experience attending and consulting on OSH competency and leadership programmes in a few countries eg Japan, Germany, Saudi Arabia, Singapore, Cambodia, India and Taiwan (The Republic of China).

Technical Officer (TO)

Mohd Fikri Hakim Bin Abdullah has an academic qualification in chemical engineering. Start working at NIOSH in Jan 2021 as an executive. He is responsible for technical services activities in the Gas Detector Calibration Laboratory (GCL) such as development, modification, verification and validation methods, and analysis of results, including statements of conformity. He is also involving in Consultation, Research, and Development activities such as Consultancy, Audit, Research and development (R&D), and Training and information dissemination that will expand the understanding of OSH issues to the workers. He hopes he can gain more knowledge and experience while working at NIOSH.

Technical Assistant (TA)

Muzhafar Bin Ibrahim have joined NIOSH in 2015. He is responsible to calibrate the sample gas detector prepare the calibration report. He is also responsible to manage and keep all the laboratory documents updated. He is actively involved with Consultation, Research, and Development activities such as consultancy, audit, research and development (R&D), and Training and information dissemination that will expand the understanding of OSH issues to the workers. He hopes he can expand his knowledge and experience while working at CRDD NIOSH.

Approved Signatory

Muhammad Akmal Muzhafar Azman Wong has an academic qualification in mechatronic engineering. He joined NIOSH in 2014 and initially starts as a laboratory technician in Industrial Hygiene Analytical Laboratory, NIOSH. He involves with several testing parameters which involve equipment such as Inductively Coupled Plasma – Optical Emission Spectrometry (ICP-OES), Microbalance, X-ray Diffraction (XRD), etc. On 2015, he starts involves in the process for Portable Gas Detector Calibration and he assisted NIOSH GCL to receive accreditation by ISO/IEC 17025 on 2016. He is also a Registered OYK, Authorised Gas Tester with the Department of Occupational Safety & Health (DOSH). On 2018, he is assigned as an Approved Signatory for Calibration of Gas Detector for NIOSH GCL. As an Approved Signatory, he is responsible for technical services activities in the GCL such as development, modification, verification and validation methods, and analysis of results, including statements of conformity.

He is also involved in Consultation Services such as Safety Audits such as OSH in Tahfiz (JAKIM), PLKN (National Service Training Department, Ministry of Defence), MFLS (Ministry of Youth & Sport), Sapura Energy Fabrication Yard. Apart from that he is also involved in module development such as AGTESR for Trainer & Assessor. Aside from that, he is also a trainer for NIOSH for several programmes such as Confined Space Programmes (AESP, AGTES), OSH-Coordinator and Safety Passport Programmes (ANSP, CSP, NTMSP).

11.2 GCL Services & Way Forward

Currently, the laboratory offers services such as gas detector calibration, research collaboration, inter-laboratory comparison and site calibration. The details are as below:

1. Gas detector calibration:
   - conducted in a controlled environment to comply with the calibration procedures;
   - performed in triplicate to acquire the best measurement uncertainty;
   - performed by competent personnel and technical experts; and the result is endorsed by the Approved Signatory, which is approved by the Department of Standard Malaysia.

2. Research calibration:
   - Gas sensor validation and verification for the marine sector;
   - Atmospheric measurement and monitoring in water tunnel; and
   - Atmospheric monitoring for air environment.

3. Inter-calibration comparison:
    - Proficiency test among the accredited laboratory for electrical testing; and
    - Sharing and exchanging information regarding gas detector calibration.

4. On-site Testing and Calibration (with the acceptable environmental condition):
    - In-house gas detector calibration at other NIOSH branch offices;
    - In-house gas detector calibration at client premise; and
    - Site testing at any venue especially at an industrial area/ park.

5. Exploring the scope of calibration for fixed/ permanent gas detector:
    - Focus on workplace areas such as calibration, workshop and workstation;
    - Extended to a public area such as a shopping complex, airport and public station.

6. Calibration with the manufacturer:
    - Sensor manufacturing and validation;
    - Certified technical centre for gas detector maintenance, repair and calibration.

Table 5.0 Below is the summary of GCL activity:

Items	Activities/ Organizations	Year
Accreditation	ISO 17025:2017	2016
	Extension of Scope ISO 17025:2017: Site Calibration	2022
Talks/ Sharing	FB Live: The importance of calibration  https://fb.watch/d_0qkU35PN/	2021
Exhibition	Carnival OSH 4 US	2021
	Carnival OSH	2022
	World OSH Day	2022

Inter-Laboratory Comparison	One GasMaster Sdn Bhd	2019
	Active Acoustic Engineering Sdn Bhd	2020, 2021
	National Metrology Institute of Malaysia (NMIM)	2021
Collaboration	Universiti Malaysia Terengganu (UMT)	2022
Training	Drager: CC Vision instruction briefing	2012
	MSA: Operational and calibration for gas detector calibration	2012
Infographics	https://gcl-infographic.tumblr.com/	2020 - 2021

Table 6.0 List of gas detectors calibrated by GCL

MSA	Altair 5X
	Altair 5XiR
	Altair 4X
Drager	X-AM 8000
	X-AM2500
	X-AM 7000
	X-AM 3000
	X-AM 3500
	X-AM 5600
Rae System	MultiRae PGM 6208
	MiniRae Lite PGM 7300

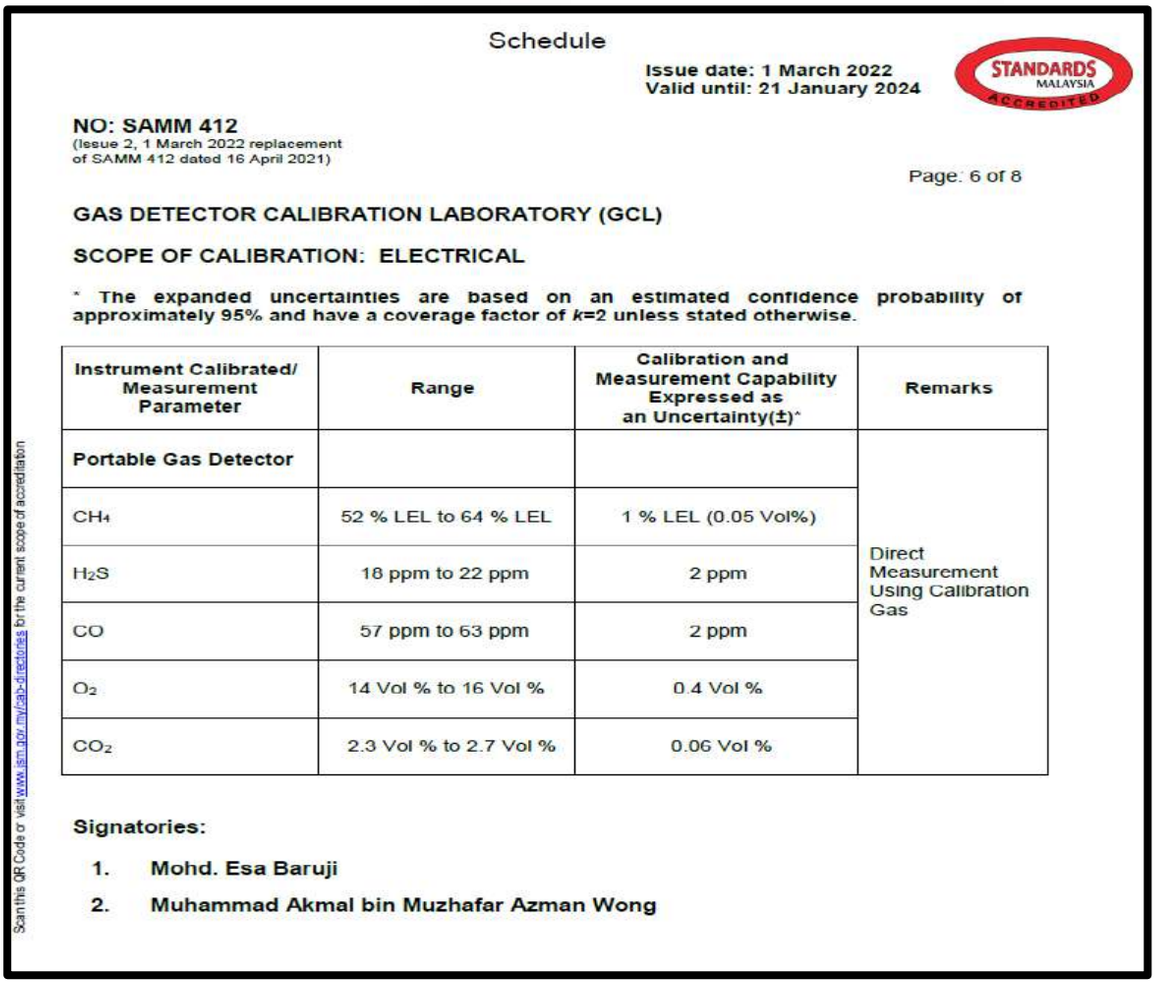
	
Bw Technologies 	MicroClip XL

11.3 FEW LIST OF GCL'S CLIENTS

1. PETRONAS Gas Berhad.
2. Linde Engineering Malaysia Sdn. Bhd.
3. EP Engineering Sdn Bhd.
4. Metcal Technologies Sdn Bhd.
5. Interglen Sdn. Bhd.
6. Bird Technology Sdn. Bhd.
7. Universiti Sains Malaysia (USM)

NIOSH Regional & Site Offices (Kepala Batas, Manjung, Ayer Keroh, Senai, Pengerang, Kuantan, Kertih, Kota Bahru, Kuching, Bintulu, Kapit, Miri, Labuan, Kota Kinabalu, Sandakan and Tawau).

11.4 ACHIEVEMENT AND ACTIVITIESSAMM Accreditation



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NO: SAMM 412
(Issue 2, 1 March 2022 replacement of SAMM 412 dated 16 April 2021)

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GAS DETECTOR CALIBRATION LABORATORY (GCL)

SCOPE OF CALIBRATION: ELECTRICAL

*** The expanded uncertainties are based on an estimated confidence probability of approximately 95% and have a coverage factor of *k*=2 unless stated otherwise.**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Portable Gas Detector			Direct Measurement Using Calibration Gas
CH_4	52 % LEL to 64 % LEL	1 % LEL (0.05 Vol%)	
H_2S	18 ppm to 22 ppm	2 ppm	
CO	57 ppm to 63 ppm	2 ppm	
O_2	14 Vol % to 16 Vol %	0.4 Vol %	
CO_2	2.3 Vol % to 2.7 Vol %	0.06 Vol %	

Signatories:

1. **Mohd. Esa Baruji**
2. **Muhammad Akmal bin Muzhafar Azman Wong**

Scan this QR Code or visit www.jsm.gov.my/cab-directories for the current scope of accreditation

Figure 11.8 Research Collaboration with Universiti Malaysia Terengganu (UMT)

Figure 11.9 Visit to the National Metrology Institute of Malaysia (NMIM)

Figure 11.10 Exhibition OSH 4 All at Port Dickson

Figure 11.11 Visit from Authorised Gas Tester & Entry Supervisor (AGTES) for Confined Space participants program

Figure 11.12 FB Live: OSHTalk

Figure 11.13 Visit from Confined Space Safety (CST) participant

Figure 11.14 Site Calibration Portable Gas Detector at NIOSH Regional Office NIOSH

HYDROSTATIC AND REFILLING LABORATORY (HRL)

12

HYDROSTATIC AND REFILLING LABORATORY (HRL)

Azhar Ahmad, Mohd Atif bin Sholehuddin

12.1 INTRODUCTION TO HYDROSTATIC AND REFILLING LABORATORY (HRL)

In early 2014, the idea to establish HRL was raised due to rising in the Self-Contained Breathing Apparatus (SCBA) Cylinder maintenance cost. Previously, all SCBA Cylinders were maintained by the appointed service provider. However, due to the increasing number of Confined Space Courses, the number of required SCBA cylinders similarly increase to accommodate the course requirements. Therefore, HRL was established with 2 main purposes:

1) To provide maintenance services including a hydrostatic test for SCBA Cylinders in NIOSH.
2) To demonstrate hydrostatic test for Confined Space Courses; Authorised Gas Tester and Entry Supervisor for Confined Space (AGTES) and Confined Space Trainer (CST).

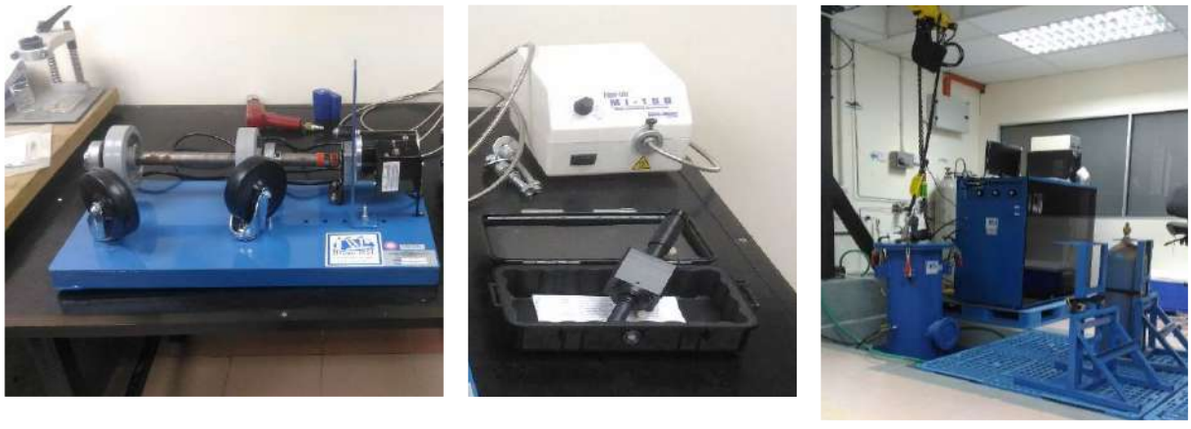


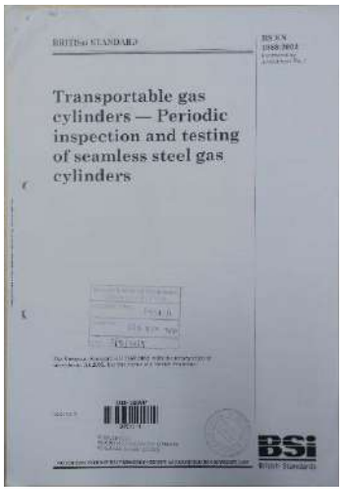
Figure 12.0 Corrosion test station, visual inspection station, and hydrostatic station.

12.2 HYDROSTATIC AND REFILLING LABORATORY (HRL) FUNCTION

In February 2015, HRL was fully established with 2 main facilities, a hydrostatic test facility and a cylinder refilling facility. Hydrostatic tests were conducted in the hydrostatic test facility following the International Standards requirement:

1) BS EN 1962:2002 for steel SCBA cylinders; and
2) ISO 11623:2017 for composite SCBA cylinders.

Steel SCBA Cylinders



Composite SCBA Cylinders

Figure 12.1 International Standards for Hydrostatic Test

12.3 HYDROSTATIC AND REFILLING LABORATORY (HRL) PERSONNEL COMPETENCY

To develop the competency of HRL personnel, hands-on training and commissioning were conducted on 14-15 January 2015 by Hydrotest Engineer, Mr. Carlos Graca. Since 2019, several training programmes have been conducted to fulfill ISO/IEC 17025 accreditation requirements such as Understanding and Implementing of ISO/IEC 17025:2017 General Requirement for the Competency Testing and Calibration Laboratories, Measurement of Uncertainty for Mechanical Testing and Method Validation & Verification.

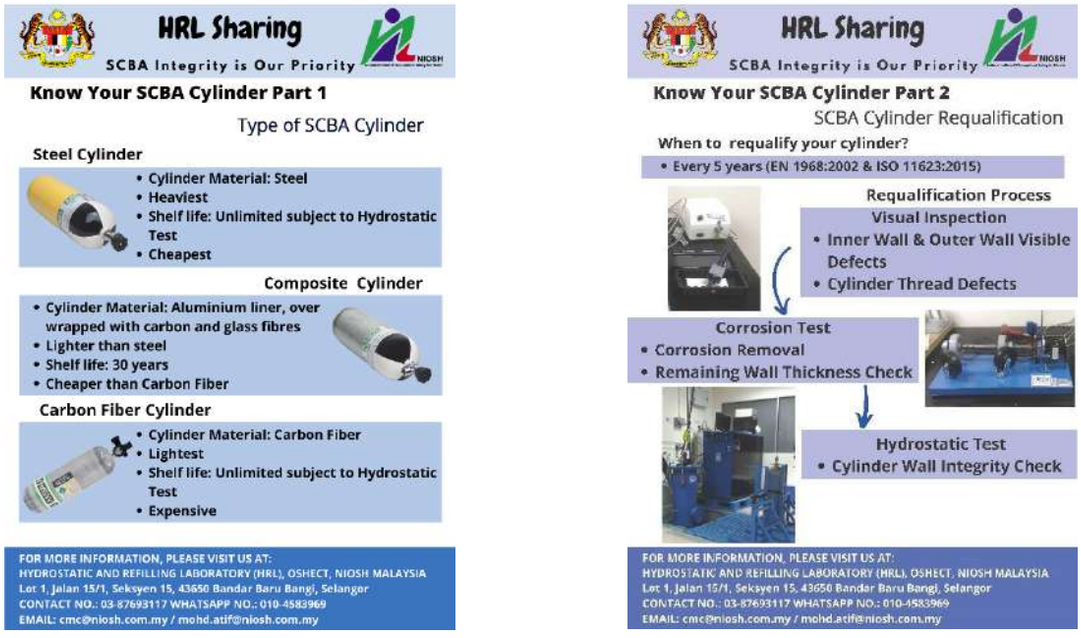
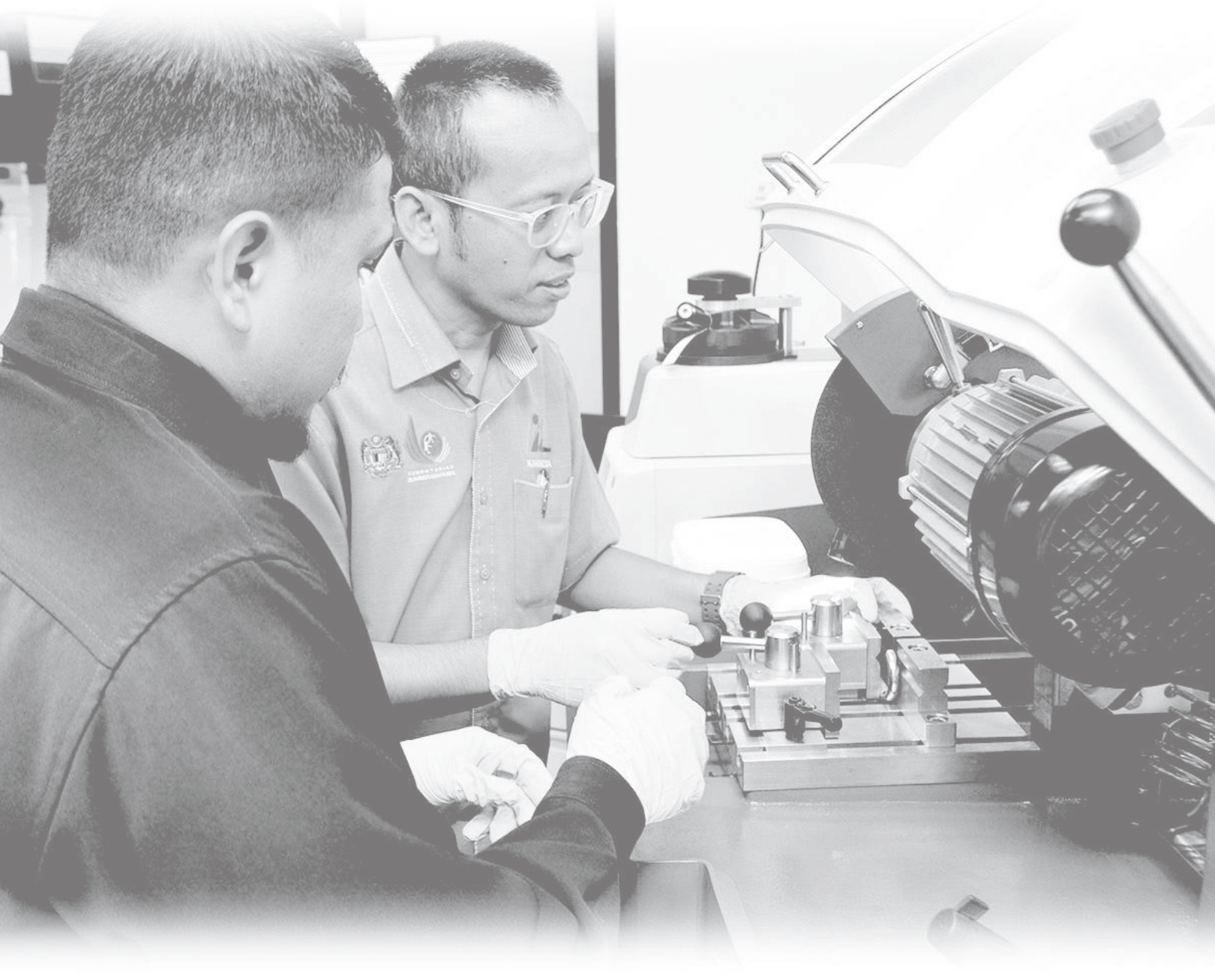


Figure 12.2 HRL Infographic and Online Sharing Session

FORENSIC ENGINEERING LABORATORY
(FEL)



13

FORENSIC ENGINEERING LABORATORY (FEL)

Ts. Hj. Mohd Esa bin Baruji, Mohamad Hanafi Ali, Muhamad Akmal muzhafar Azman Wong

13.1 INTRODUCTION TO FORENSIC ENGINEERING LABORATORY (FEL)

Forensic Engineering Laboratory(FEL) was established in 2020, to investigate the causes of workplace accidents on a micro basis through engineering, technical and scientific principles. Using current knowledge, the cause of the accident can be determined whether due to a structural, mechanical, component, or material failure. Currently, our lab has established collaboration with several international/ local institutions eg NIOSH Japan (JNIOSH), Korea OSH Agency (KOSHA) and Universiti Kebangsaan Malaysia (UKM) in terms of expertise, technology & equipment. For example, during the initial establishment of this laboratory, FEL has undergone intensive training with the National Institute of Occupational Safety & Health Japan (JNIOSH) to enhance staff expertise and experience as well as technology in operating such laboratories. This intensive training has provided basic exposure related to the operation of research laboratories, development, and accident investigation.

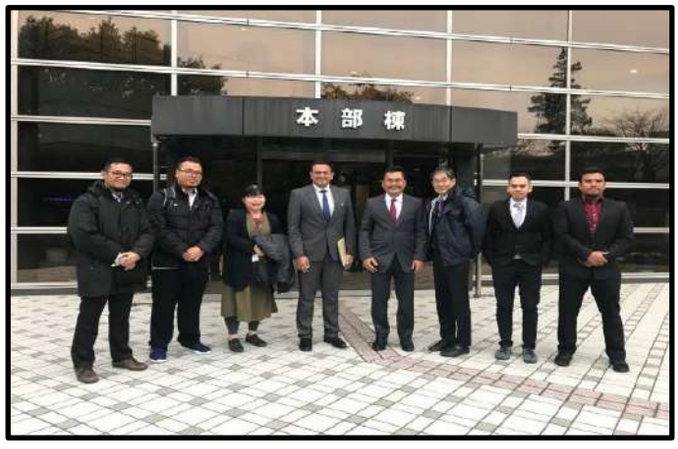


Figure 13.0 Top Management and FEL NIOSH Team in JNIOSH, Japan for Technical Visit and Training Attachment – FEL Capacity Development Program

The objectives of the establishment of FEL are;

- To provide technical services for **investigating the root causes** of an incident;
- To formulate **technical safety recommendations** for the industries to prevent industrial accidents;
- To **conduct scientific research** for risk reduction of industrial accidents and create a safer and comfortable work environment; and
- To **collaborate with the government and industries** on an accident prevention programme.
-

Meanwhile, the function of the establishment of FEL is:

- Analyze scientific evidence collected from the accident site or vice versa;
- Prepare technical report by NIOSH technical expert based on the scientific evidence
- Provide basic engineering workshop safety; and
- Produce prototype for pre-commercialization purposes or research.

13.2 IN GENERAL, FEL SERVICES COMPRISE:

- **Microscopic Examination**
  - Evaluation of fracture surfaces
- **Metallographic/ Metallurgical Analysis**
  - Examination of porosity, cracks, grain size, segregation & distribution of phase
- **Mechanical Test (Vickers Hardness Test)**
  - Measurement of sample hardness value
- **3D Prototype Printing**
  - Fabrication of prototype

Figure 13.1 FEL services

13.3 WHILE THE FEL TESTING FACILITIES INCLUDE:

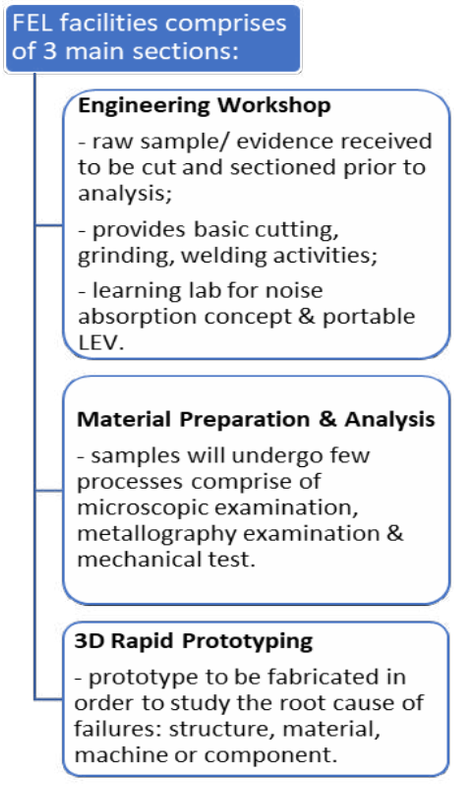


Figure 13.2 FEL testing facilities

And milestone of FEL as per below:

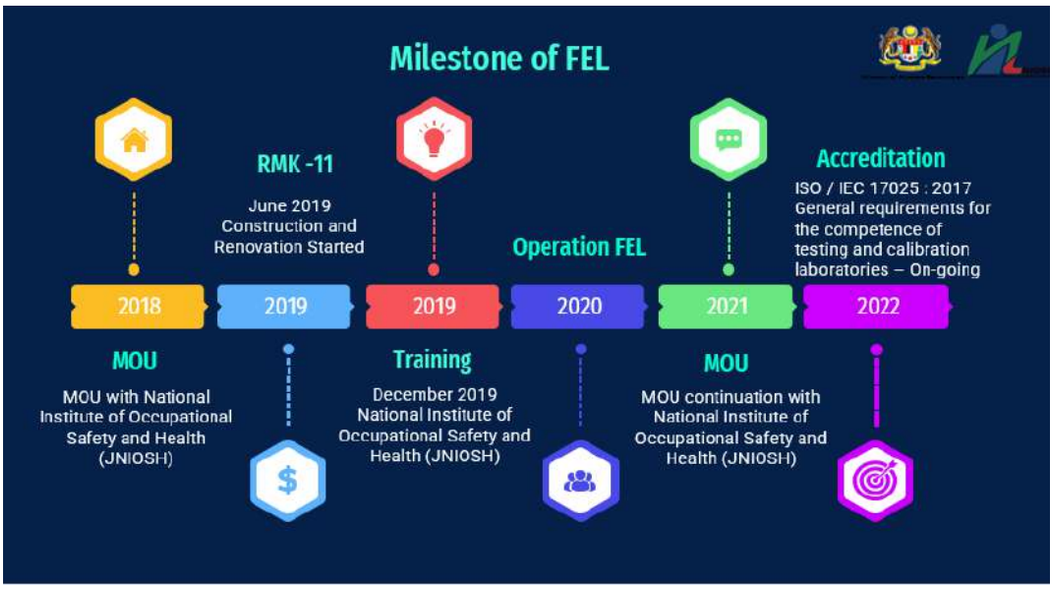


Figure 13.3 Milestone of FEL until 2022

BIBLIOGRAPHY OF FEL TEAM MEMBERS

Name:

- Hj. Khairunnizam bin Mustapa

Designation:

- General Manager, Consultation, Research & Development Dept. (CRDD), NIOSH
- Management Representative (MR), OSHECT

Education:

- Master of Science (Occupational Safety and Health Management), Universiti Utara Malaysia (UUM)
- Bachelor of Business Administration (Hons) Majoring in International Management, Universiti Utara Malaysia (UUM)

Name:

- Ts. Haji Mohd Esa bin Baruji

Designation:

- Technical Expert 1 (Principle Consultant/ Researcher), Consultation, Research &Development Dept. (CRDD), NIOSH
- Laboratory Advisor (LA), FEL

Education:

- Bachelor of Engineering in Electronics from the University of Manchester Institute Science & Technology (UMIST), Manchester, United Kingdom
- Master in Industrial Safety Management from the National University of Malaysia (Dean List)

Name:

- Mohamad Hanafi bin Ali

Designation:

- Executive, Consultation, Research &Development Dept. (CRDD), NIOSH
- Technical Officer (TO), FEL

Education:

- Master of OSH Risk Management, Open University Malaysia (OUM)
- Bachelor of Environmental and Occupational Health, Universiti Putra Malaysia (UPM)

Name:

- Mohd Atif bin Sholehuddin

Designation:

- Executive, Consultation, Research &Development Dept. (CRDD), NIOSH

Education:

- Master of Process Safety and Loss Prevention, Universiti Putra Malaysia (UPM)
- Bachelor of Engineering (Honours) (Chemical Engineering, Universiti Sains Malaysia (USM)

FEL EQUIPMENT

Below are the technical equipments available at FEL.

Table 7.0 The equipment available in FEL

Metallographic Abrasive Manual Cutting Machine

Function: Raw sample received to be cut and sectioned before analysis

Metallographic Automatic Mounting Press Machine

Function: To facilitate the process of surface analysis and hardness testing

Metallographic Semi-Automatic Grinder-Polisher

Function: To clean and smooth the surface of the sample

Micro Hardness Tester

Function: Determine the hardness value of the sample

Metallurgical Microscope with Microscopy Camera & Analysis Software

Function: Surface sample to be analysed by microscopic examination

3d Printer for Rapid Prototyping

Function: 3D Prototype to be fabricated to study the root cause of an accident, for pre-commercialization purposes or research.

In line with the objectives of the establishment, various activities and programmes have been planned and have been conducted at the laboratory level including:

1) Cross-sectional and corrosion study for breathing apparatus cylinder and gas detector calibration cylinder

Figure 13.4 Aluminum gas cylinder & Carbon steel gas cylinder

2) Metallurgical analysis for full body harness metal parts such as lanyard and carabiner

Figure 13.5 Metal parts of full body harness & Sample of metallurgical analysis

Figure 13.6 Surface Analysis of Carbon Steel

3) Mechanical testing (Hardness Test)

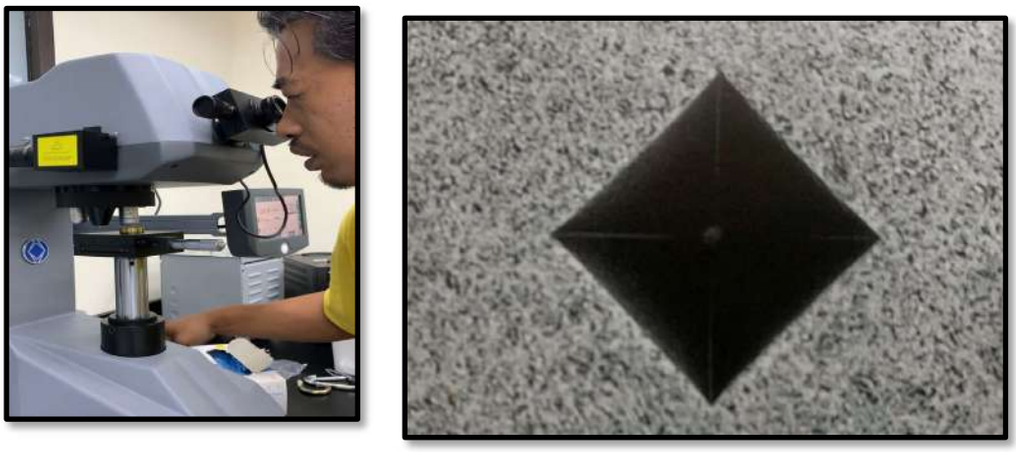


Figure 13.7 Hardness Testing & Vickers Hardness Test Analysis

4) Fabrication of 3D prototype

Figure 13.8 Fabricated of 3D prototype

Meanwhile, to ensure the existence of this laboratory is not beneficial for NIOSH, government, industries and occupational safety and health practitioners only, the laboratory also contributes to the community-based programs. Among the program is, while the country is facing the COVID-19 outbreak, NIOSH has taken proactive steps to assist COVID-19 frontliners by designing and producing a "Face Shield with Fastened Strap" using 3D Printer Technology, ProJet MJP.

This face shield was donated to the frontliners at Hospital Tuanku Jaafar Hospital, Seremban, Negeri Sembilan to be used by the Hospital staff to conduct health monitoring on their patients to suppress the spread of COVID-19. The face shield was produced by FEL itself to cover the shortage of Personal Protective Equipment (PPE) that occurred at that time.

In addition, FEL also donated this face shield to the NIOSH trainer and staff that conducted the training and other programme during the pandemic.

Figure 13.9 Donation of Face Mask to the Frontliners at Hospital Tuanku Jaafar Hospital, Seremban, Negeri Sembilan by Hj. Ayop Salleh, NIOSH's Executive Director and FEL team (Ts. Hj. Mohd. Esa, Mr Mohd Hanafi and Mr Mohd Atiff)

Figure 13.10 Hand-over of Face Mask to Training Strategic & Communication Division (TSCD), NIOSH, Mr Noorazman for NIOSH Trainer by Mr Mohd Hanafi, Technical Officer, FEL

FEL welcomes new collaboration/cooperation with any parties which are interested to explore on mechanical failure matters through joint research or consultation. Furthermore, FEL is now heading towards the accreditation of ISO/IEC 17025:2017 Competence of Testing (Mechanical) by 2022 and it is hoped that the establishment of FEL will further enhance the image of NIOSH not only in Malaysia and Asia but also at the international level.

BRITISH STANDARD

BS EN ISO 6507-1:2018

Metallic materials — Vickers hardness test —

Part 1: Test method

BSI British Standards

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 6507-1

March 2018

ICS 77.040.10

Supersedes EN ISO 6507-1:2005

English Version

Metallic materials - Vickers hardness test - Part 1: Test method (ISO 6507-1:2018)

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Figure 13.11 Reference Testing Standards IS0 6507-1:2018 for ISO 17025:2017 Accreditation

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