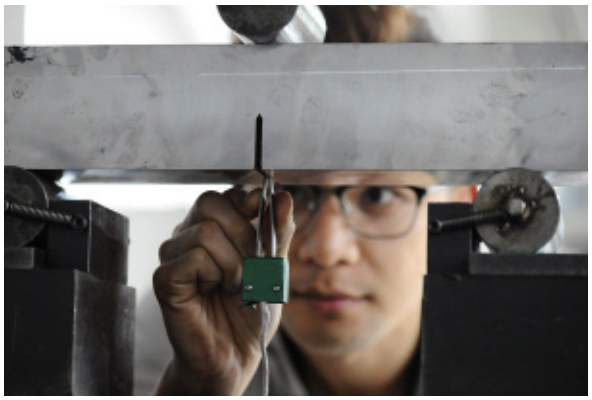
PROFESSIONAL TESTING SERVICES



A Commitment to Quality and Service

ABOUT US

Professional Testing Services is an independent Test Laboratory, first founded in 1985 in Singapore.

Since then, we have gained recognition from the Oil & Gas, Offshore Marine and Manufacturing industries as a leading provider of quick, reliable, and accurate testing of metals and metal products.

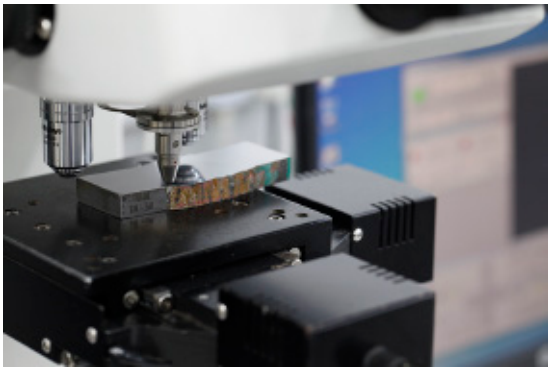
We offer a comprehensive selection of tests and inspection services including mechanical tests, chemical and metallographica analysis, corrosion tests, non-destructive tests, welding consultancy & weld inspection, failure analysis, etc.

To reach out to clients in the regions, Professional Testing Services Sendirian Berhad was established in 1995 in Johor, Malaysia; and PT Professional Technology Specialist was set up in 2004 in Batam, Indonesia. All our laboratories in Singapore, Malaysia and Indonesia are accredited to ISO/IEC 17025:2005 by SAC-SINGLAS, SAMM and KAN respectively.

With our newly upgraded facilities and equipment, and a total group size of almost 150 dedicated staff, we are confident of exceeding all our client's inspection and testing requirements.

Vision & Mission

Vision
A leading regional laboratory specializing in metal, metal products and welding.



Mission
To serve as a reliable, one stop source of inspection, testing, consultancy and training services for all our client's quality assurance needs.

WHY CHOOSE US

WE CARE

We care about our clients and will take the time to understand your testing objectives, so that we can advise on an appropriate scope of testing, always within your budget. We help you understand the inspection and testing processes and methods, and will review your results with you, to help you understand the implications of the test results on your production or process.

WE ARE EXPERIENCED

We have more than 30 years of experience in testing metals across multiple industries, and therefore are confident that we can provide our clients with practical advice on test specifications, requirements and acceptance criteria.

We ensure our team members are well trained and knowledgeable through a combination of comprehensive series of internal and external training as well as guidance from our experienced seniors, so that you can be assured that testing is always carried out competently and reliably.

WE GO FURTHER

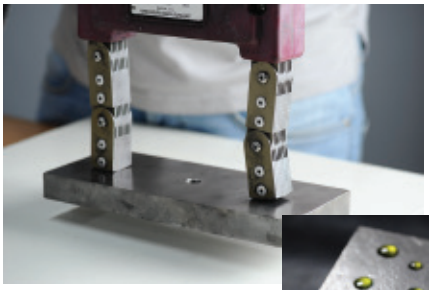
We understand that inspection and testing should always complement your production schedule, not hinder it, and so we always strive to provide you with your results in the shortest amount of time. We consistently review our entire operation, from receiving of samples to generation of test reports, and strive to be as efficient as possible, so that your production or inspection schedule will always be on time.

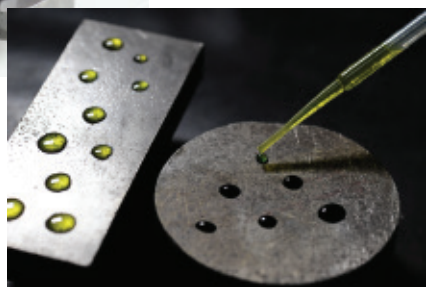
We stay relevant to new developments in testing by being involved with national and international organizations such as the Singapore Welding Society, The Welding Institute and NACE. Together with a dedicated in-house R&D department, this allows us to develop and roll out the latest tests required by our client's industries, allowing us to always be able to cater to all your testing requirements.

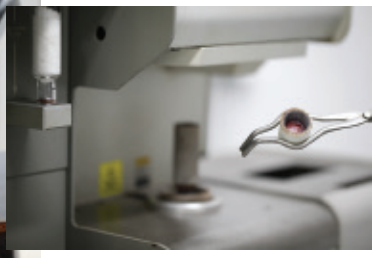
PTS SERVICES

Non Destructive

- Radiographic Test
- Ultrasonic Test via Manual and Immersion Method
- PMI - Spark Optical Emission Spectrocopy
- PMI – X-Ray Fluorescence Method
- Magnetic Particle Inspection
- Liquid Penetrant Inspection
- Ferrite content measurement (Feritscope)
- In-situ Replica Metallography
- Iron Contamination Test (Ferroxyl + Copper Sulphate Test)
- Portable Hardness Test (Vickers/Rockwell/Brinell)







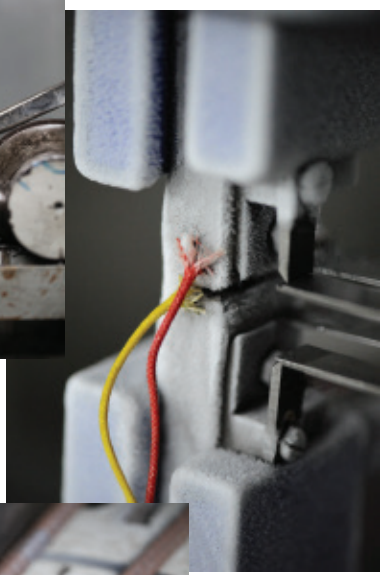
Chemical

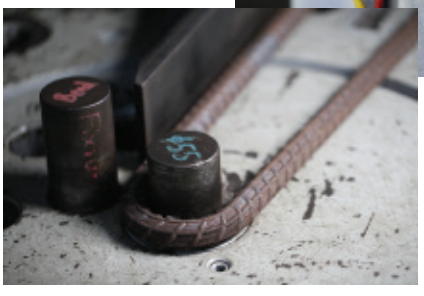
- Determination of Diffusible Hydrogen Content
- Determination of Metal Composition Via
  - Spark Optical Emission Spectroscopy (Spark - OES)
  - Carbon & Sulfur Analyser (Combustion method)
- Determination of Moisture Content

PTS SERVICES

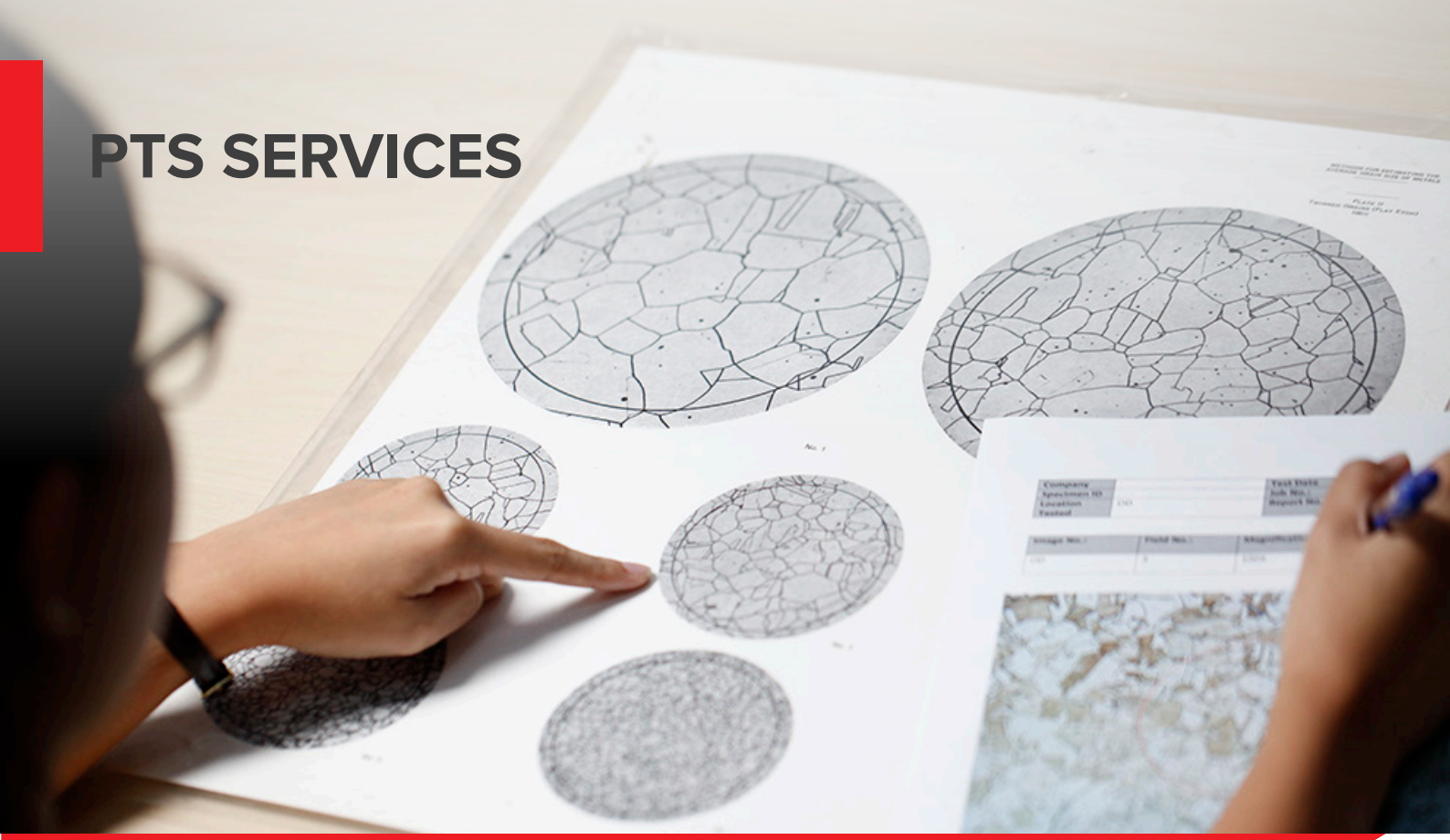
Mechanical

- Charpy Impact Test (at Various Temperatures)
- Bend Test
- Nick-Break Test
- Fracture Test
- Flanging Test
- Flaring Test
- Flattening Test
- Shear Test
- Compression & Proof Load Test
- Transverse Weld Tensile
- All-Weld Tensile
- Through Thickness Tensile
- Tensile Test at Elevated Temperature (up to 1200°C)
- Reinforcement Bar / Wire Mesh
- Crack Tip Opening Displacement (CTOD) via SENT and SENB method



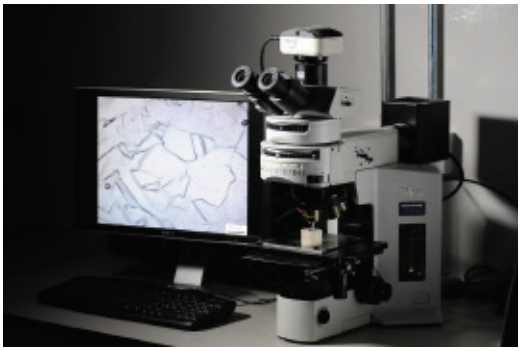


PTS SERVICES



Metallographic

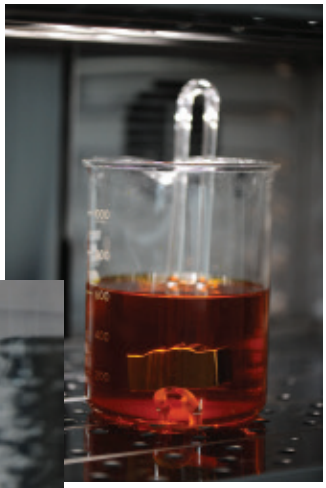
- Macro-etching Examination & Photography
- Microscopic Examination (Microstructure Examination, Inclusion content)
- ASTM Grain Size Determination (Using Comparison Charts for Untwinned Grains, Twinned Grains & Austenite Grains in Steel: McQuaid-Ehn)
- Scanning Electron Microscopy (SEM) / Energy Dispersive X-Ray (EDX) Analysis
- Ferrite Content by Point Count Method (Lab-based)

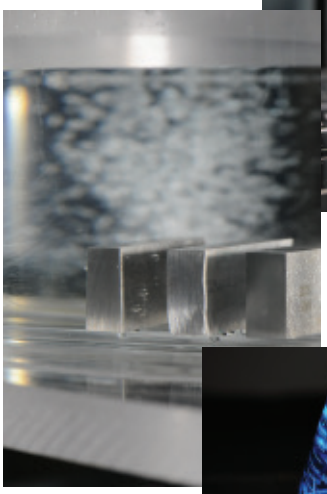


PTS SERVICES

Corrosion

- Pitting Corrosion
- Crevice Corrosion
- Intergranular Corrosion
- Hydrogen Induced Corrosion (HIC)
- Sulfide Stress Cracking & Stress Corrosion Cracking (SSC & SCC)
- Weathering Tests (Salt Spray)
- Exfoliation Corrosion
- Scanning Electron Microscopy (SEM) Examination
- Energy Dispersive X-Ray (EDX) Spectroscopy
- Intermetallic Phase Detection
- Coating mass Measurement

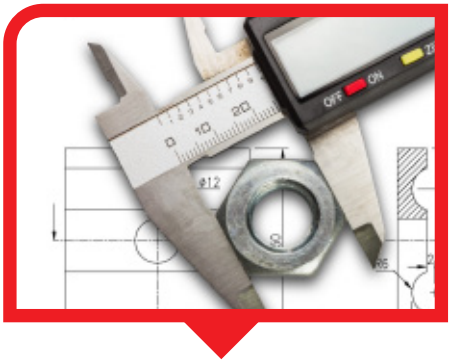




Welding Services

ONE-STOP WELDING SUPPORT

1. Specifications Codes Standards



- Provide Consultation to Review Project Requirements and /or Project Specification
- Responsible Welding Coordinator Service in preparation for compliance to ISO 3834

2. Purchase of Materials

- Welding Consumables Batch Test
- Provide consultation on Material Weldability Grouping, Welding Consumable & Base Material Matching and Alternate Joining Methods

3. Welding Procedure Qualification

- Monitoring of Welding Procedure Qualification at Laboratory & on Site
- Production Welding Monitoring by Qualified Inspector
- Documentation of WPS, PQR & WPQT
- Welder & Welding Operator Performance Qualification Test
- Recertifying & Requalifying Welders
- Welder Training (To prepare for Procedure / Welder Qualification)

Welding Services

ONE-STOP WELDING SUPPORT

4. Fabrication & Production

- Site Survey of Welded Structures
- Welding Visual Inspection (Laboratory & Site)
- Provision of Welder Training (Theory & Practical)
- Provide Consultation to implement Good Work Practice Procedure

5. Welding Consultancy

- Review Welding Documents
- Writing Pre-Qualified / Standard Welding Procedure
- Provide consultation to improve Welding Efficiency and/or economics
- Welding Research & Development

6. Capabilities

- 2 Welding Engineers, 2 Welding Technologists, 3 Welding Specialists, 7 AWS-CWI and 6 CSWIP 3.1
- 6 Welding Specialists : 6G Position, All Steel Family, Nickel Based, Aluminum
- GTAW (AC, High Frequency Start), SMAW (Up to 400A), GMAW (Modified Pulse Wave), FCAW
- Portable Arc Monitoring and Gas Purity Monitoring Systems
- Temperature Monitoring (Pre-heating, Post-heating)

Failure Analysis

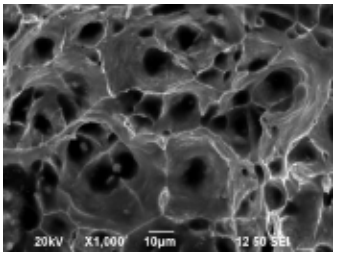
Failure analysis is a process that is performed in order to determine the causes or factors that have led to an undesired loss of functionality.

Types of Failure Analysis:

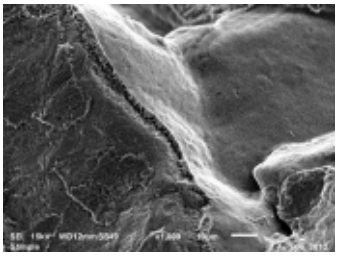
- Failure Mode Determination
- Fractographic Analysis
- Metallographic Interpretation
- Contamination Analysis
- Corrosion Analysis
- Particle Analysis And Identification
- Surface Analysis

FRACTOGRAPHIC ANALYSIS

Equiaxed Ductile Dimples (Micro-voids Coalescence)

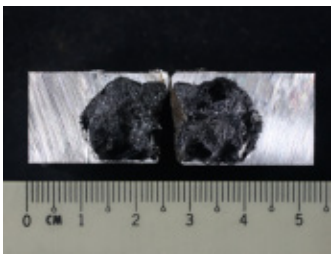


Brittle Intergranular Cracking



CORROSION ANALYSIS

Pitting Corrosion of Austenitic Stainless Steel

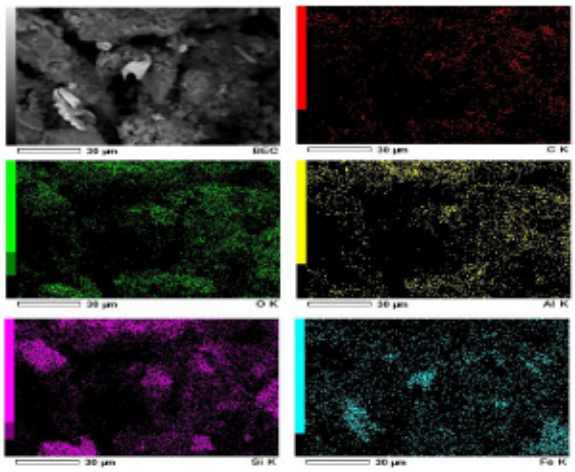


Microbiological Induced Corrosion of Seachest Filter

Failure Analysis

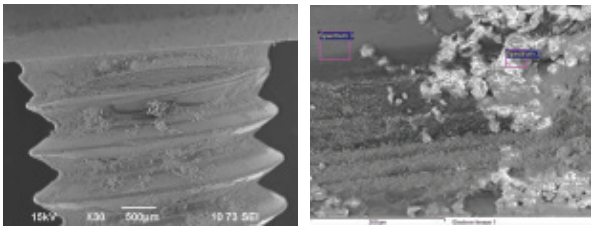
PARTICLE ANALYSIS AND IDENTIFICATION

Case Study: EDX (Mapping Function) to identify a mixture of paticles. Iron shavings found in sand (Si, Al, O-rich).



CONTAMINATION ANALYSIS

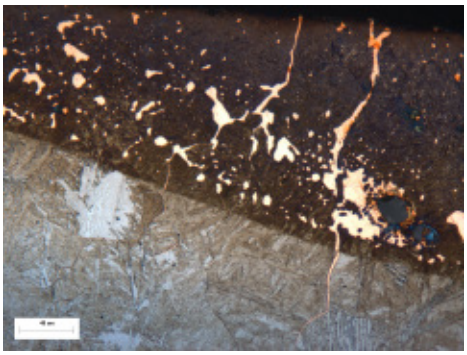
Case Study: The presence of large amounts of zinc and oxygen in deposits on the thread suggested that the deposits consisted of predominantly oxidation products of zinc.



METALLOGRAPHIC EXAMINATION

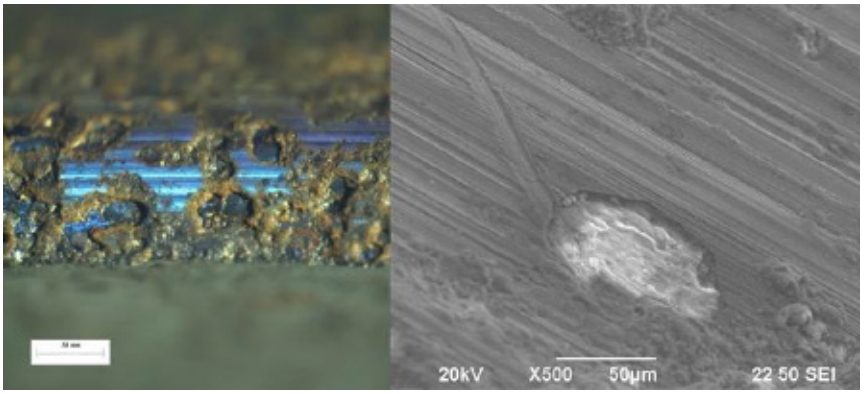
Branching Transgranular Chloride Stress Corrosion Cracking of Austenitic Stainless Steel

Copper LME (Liquid Metal Embrittlemnt)



SURFACE ANALYSIS

Case Study: Unpolished lathe-cut marks and pits at fillet radius of shaft, acting as stress concentration sites.



KEY INDUSTRIES

Marine and Offshore

Problem: Ship hull steels and welds require good fracture toughness properties due to the possibility of brittle fracture in a low temperature service environment. The simple Charpy impact test gives only a qualitative indication of the material toughness.

Solution: **Crack Tip Opening Displacement (CTOD) Testing**

PTS can perform fracture mechanics toughness test to quantitatively measure fracture toughness of a full size specimen containing a genuine crack at a loading rate more representative of service conditions. This would facilitate designers to perform a fitness for purpose analysis and calculate critical defect size to determine if cracked components can be used until it can be repaired.

Problem: Repairs works at shipyards would require replacement of metal components within a fast turn-around time. It is imperative to obtain satisfactory alloy materials to be used for repair that is in accordance with the relevant shipping Class.

Solution: **Positive Material Identification (PMI) - OES & XRF**

PTS can provide on-site non-destructive techniques to quickly verify elemental composition and grade identification of alloys.

Oil & Gas

Problem: Pipelines and pressure vessels used in the oil & gas industry are often exposed to sour-service environments (containing wet hydrogen sulphide). These might lead to hydrogen-induced cracks, overstress and catastrophic rupture of the pipelines or pressure vessels.

Solution: **Hydrogen-Induced Cracking (HIC) Test**

PTS can provide corrosion tests, in accordance with NACE standards, on steels in the form of pipes, plates, fittings and flanges for use in fabrication of pipelines and pressure vessels. This would allow the evaluation of resistance to hydrogen-induced cracking.

More Solution: **Ultrasonic Test (UT)**

PTS can provide on-site ultrasonic test to detect any flaws (cracks, corrosion, etc.) within your pipelines and pressure vessels. This would allow non-destructive and early detection of any flaws, before they become critical and affect the safety and integrity of your assets.

Construction

Problem: There are a wide variety of materials that are being used in the construction industry. Some examples are structural steels, including plates, universal beams, hollow sections, channels, angle bars etc; high bolting fasteners; and reinforcement bars. Verification of materials against the mill test certificates by third party testing laboratories are often mandatory to ensure that the materials obtained possess the properties as stated in the mill test certificates.

Solution: **Tensile Test**

PTS can perform tensile tests to determine how a material will react when a force is applied in tension manner. Tensile test is one of the simplest and widely used mechanical tests to determine yield strength, ultimate tensile strength and ductility of the material.

Problem: Steel reinforcement bars are used in construction of roads, bridges, train tunnels. Parts of the structures are subjected to cyclic loading due to their operational loads. Therefore it is mandatory to evaluate high cycle fatigue property before they are being used in construction.

Solution: **High Cycle Fatigue Test (Rebar)**

PTS can perform high cycle fatigue tests for reinforcement bars. Typically, reinforcement bar has to withstand a repeated loading for millions of cycles without failure. If this requirement is met, the chances of fatigue failure while in-service can be greatly reduced.

Manufacturing & Steel Supplier

In metal manufacturing and processing industries, quality of their products is the utmost concern for our customers. PTS is able to provide the following essential tests for material fabricators and suppliers to ensure that their products are within the required specifications. Such tests may include:

- Mechanical Properties e.g. Tensile Strength, Hardness
- Chemical Composition e.g. C, P, S, Mn, Si
- Metallurgical Properties e.g. Microstructure, Ferrite Content, Corrosion Resistance

Problem: Chemical composition plays a dominant role in the range of mechanical properties attainable in carbon and alloy steels, in particularly for hardenability and weldability. Carbon equivalent (CE) and pitting resistance equivalent number (PREN) are 2 important values that could be derived from chemical composition.

Solution: **Determination of Metal Composition via Spark - OES (Lab-based)**
When your sample can be cut for lab based analysis, PTS can provide lab-based Spark OES with better detection limits and larger element ranges, than the portable method.

Problem: During welding, hydrogen is generated from the dissociation of water vapour or hydrocarbons in the welding arc. Small sized hydrogen atoms can diffuse in the weld and heat-affected zone (HAZ). These could build up and create stresses in the presence of residual tensile stresses and contribute to hydrogen (delayed) cracking.

Solution: **Diffusible hydrogen content and/or Moisture Content in Fluxes or Covered Electrodes**

PTS can provide analysis for customers that are manufacturers or suppliers of welding electrodes to determine moisture content in fluxes or covered electrodes and diffusible hydrogen content in welds.

PROFESSIONAL TESTING SERVICES

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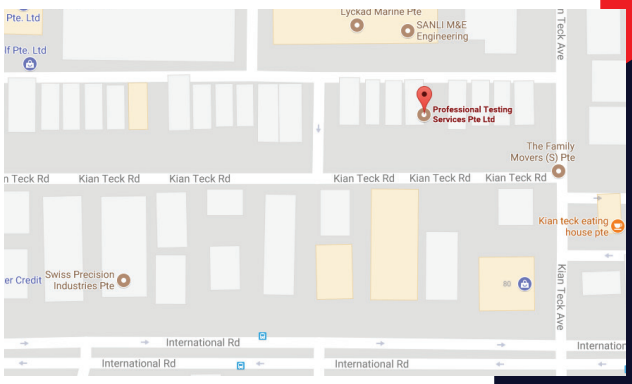

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