

TCR Engineering Services

Material Testing • Inspection • Sourcing • Contracting

Trusted QA Partner

Multi-National Locations

Spring 2010



Overview

- About TCR Engineering Services
 - History, Profile, Leadership Team
 - Global Vision and the India Advantage
 - Customers all over the world
- Quality Assurance Services
 - Material Testing Laboratory
 - Failure Analysis and Engineering Consulting
 - NDT Services
 - Third Party Inspection
 - Sourcing Assistance
 - Risk Based Inspection, Fitness for Service
 - CAD/CAM, MiC and LIMS Software
- TCR Institute for Materials Technology
- Manpower Recruitment
- Summary



Quality Assurance Experts

- **Serving Global Clients since 1973**
 - Headquartered in Navi Mumbai (India) operations in USA, Saudi Arabia, Kuwait, Malaysia and Nigeria
 - Over 2500+ Customers in India and Overseas
 - ◆ India location of TCR is preferred back-end outsourced quality assurance center for some of the world leading companies
- **State-of-the-art Material Testing and Engineering Research Facility**
 - Metallurgical Testing Labs in Mumbai and Vadodara are both accredited to BIS, ISO 17025 and NABL standards
 - NDT and PWHT services in Saudi Arabia are approved by SABIC, Saudi Aramco, SWCC and Saudi Electric Company
- **Strong Team comprising of Metallurgists, Corrosion Engineers, Failure Analysis Investigators, Welding Inspectors, ASNT Level III experts and NDT Technicians under one roof**
 - 120 team members in India, 46 in Saudi Arabia, 53 in Kuwait
- **Constant Innovation and Research**
 - Documenting Knowledge and Experience over the years
 - Addition of New Equipment and Cross-Training of Employees
 - Papers published and workshops conducted by Leadership Team



Accreditation of TCR Engineering



- ISO 17025, NABL and Bureau of Indian Standards (BIS) accredited
- International Acceptance of Test Reports
 - NABL is a signatory to International Laboratory Accreditation Cooperation (ILAC) and Asia Pacific Laboratory Accreditation Cooperation (APLAC)
- TCR is approved by Clients qualification programs
 - Halliburton, Schlumberger, Siemens, L&T, Wartsila, EIL, Reliance, Caterpillar, ONGC, Indian Defense, Saudi Aramco

Approvals



Serving Multiple Industry Verticals

Onshore O&G plants



Offshore Oil Plants



Construction



Pharma and Biotech



Refining & Chemicals



Power Generation



Pulping



Mining & Metals



Electronics



Automotive



Defence



Aerospace



Manufacturing



Shipping



Manufacturing Goods



Medical Products



Loyal Customers in India - TCR Engineering Services



The World is Flat – Outsource Testing to India



- TCR's lab personnel hardened by virtue more project testing and QA experience
 - All personnel are well versed in understanding ASTM, NACE, AWS, ASME, API, BS and Indian Standards
- High Quality Contract Research
 - In-depth Failure Analysis Studies
 - Welder Qualification
 - NDT Procedure Writing
 - Corrosion Studies
 - Wet & Spectro Chemical Analysis
 - Elevated Temperature Mechanical
 - Specimen Preparation Machining
- Fast turnaround with final test reports communicated by e-mail

Global Customers – TCR Group of Companies

Logos of TCR Group of Companies customers in the Middle-East region include: NPCC, PERMA-PIPE, Zamil Air Conditioners, Saudi Aramco, GMMOS, Kirby Building Systems, Petrochemical Industries Company, HYUNDAI HEAVY INDUSTRIES CO., LTD., SFCC, PM, KNPC, and ARIRANA AFGHAN AIRLINES.

Middle-East

Logos of TCR Group of Companies customers in the USA, Canada and Mexico region include: PEACE CORPS, ELLIOTT EBARA GROUP, EPT, BECHTEL, AIS, HALLIBURTON, CATERPILLAR, Schlumberger, FISHER, GE, HIS, Chevron, CONSTAR International Inc., Stoneridge, Komline-Sanderson, Weatherford, and GenTech.

USA, Canada and Mexico

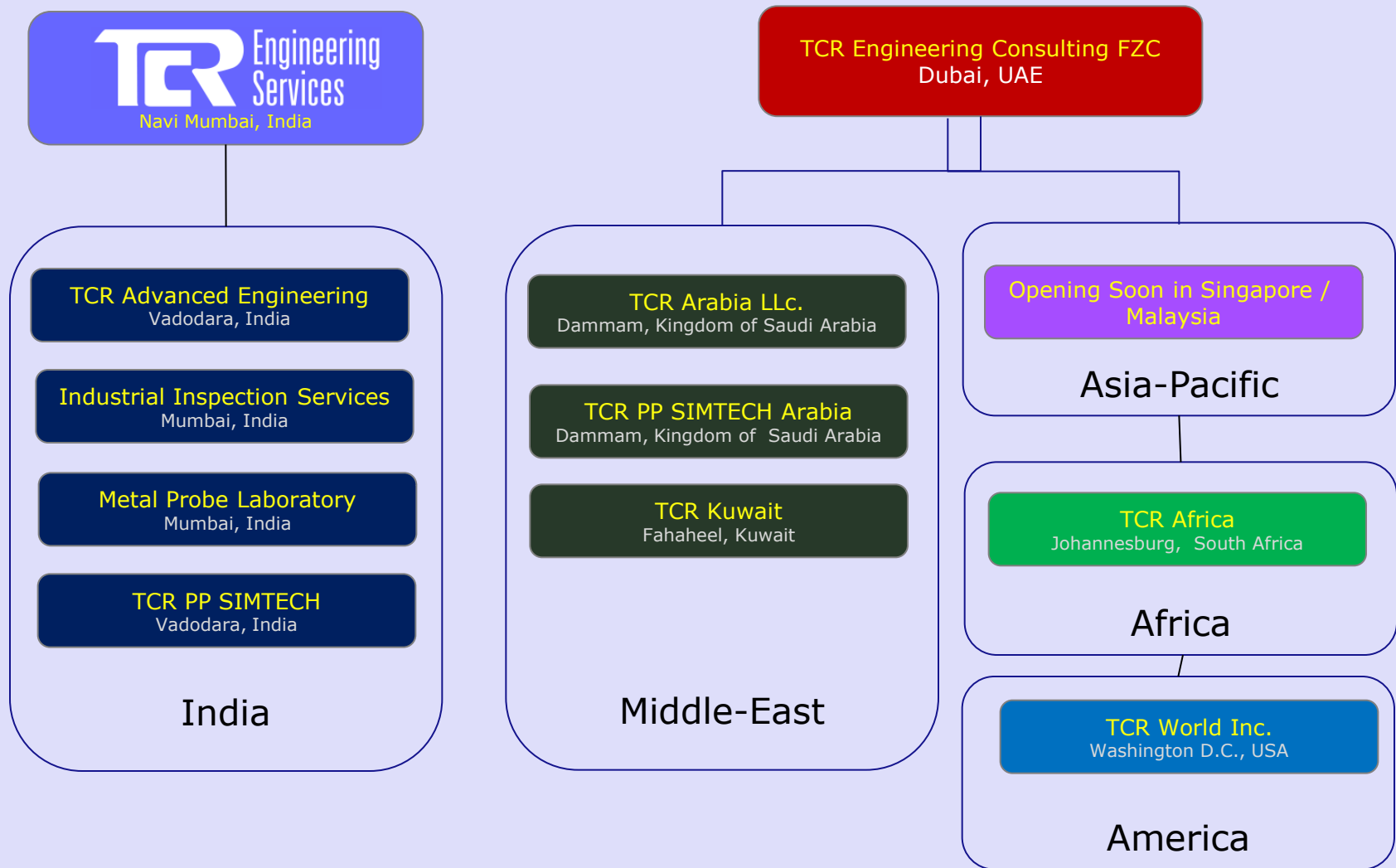
Logos of TCR Group of Companies customers in Europe and Africa region include: FLOWERVE, STORK, EXPAMET BUILDING PRODUCTS, Global Fasteners Limited, METPOST, SIEMENS, TECHNIMONT ICB, Saipem, Eni, MBH ANALYTICAL LTD, bloxwich, PROPLANT, and WÄRTSILÄ.

Europe and Africa

Logos of TCR Group of Companies customers in the Asia-Pacific region include: MITSUBISHI, Johnson screens, HYDRO, Unilever, LG, SINOPEC, PURAPOOL, SHENZHEN JUTAL MACHINERY EQUIPMENT CO.,LTD., ENERFLEX, HIDROFLEX, PETRONAS, and XALOY.

Asia-Pacific

Company Organization Structure

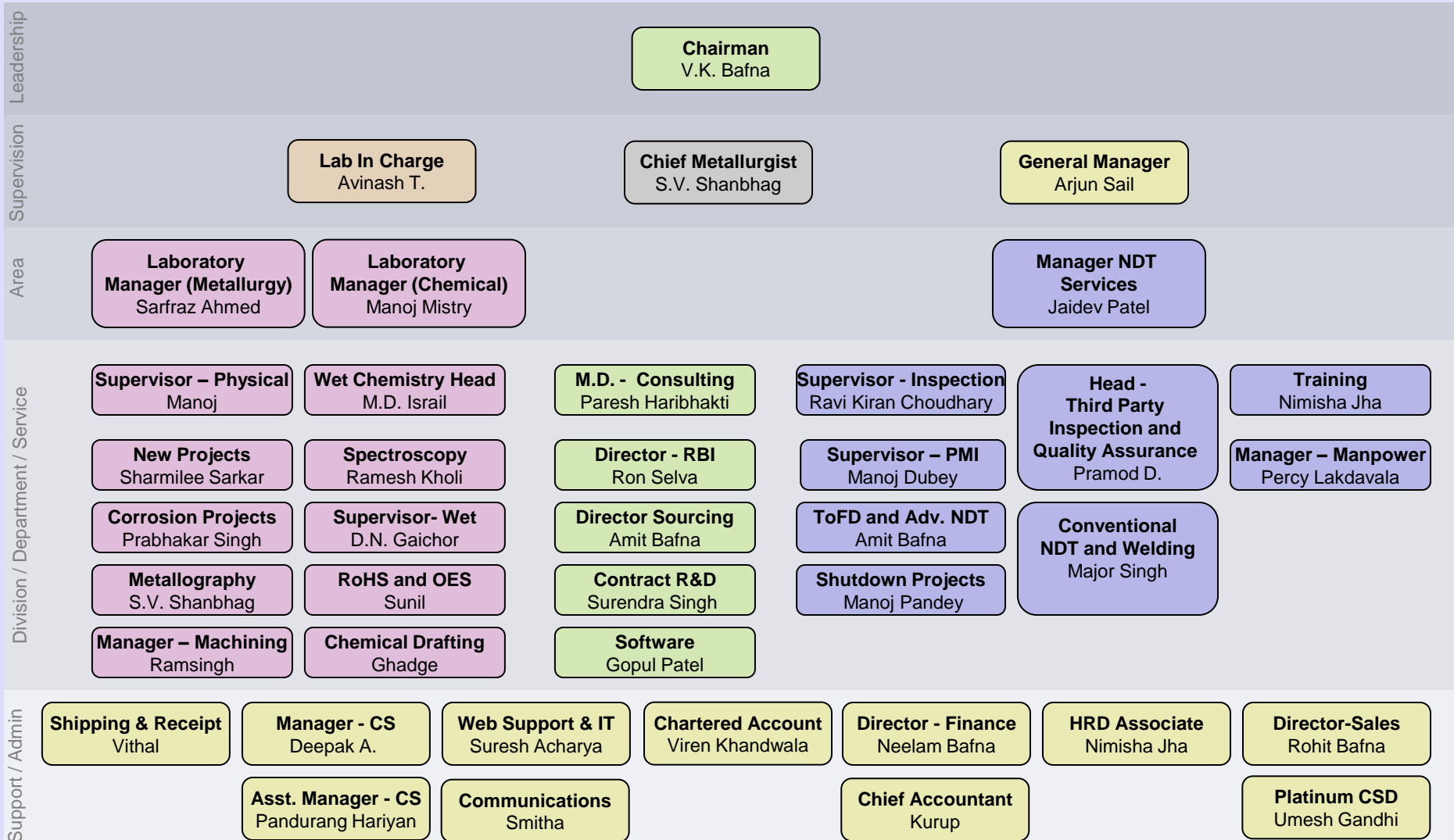


Strong and Experienced Leadership Team

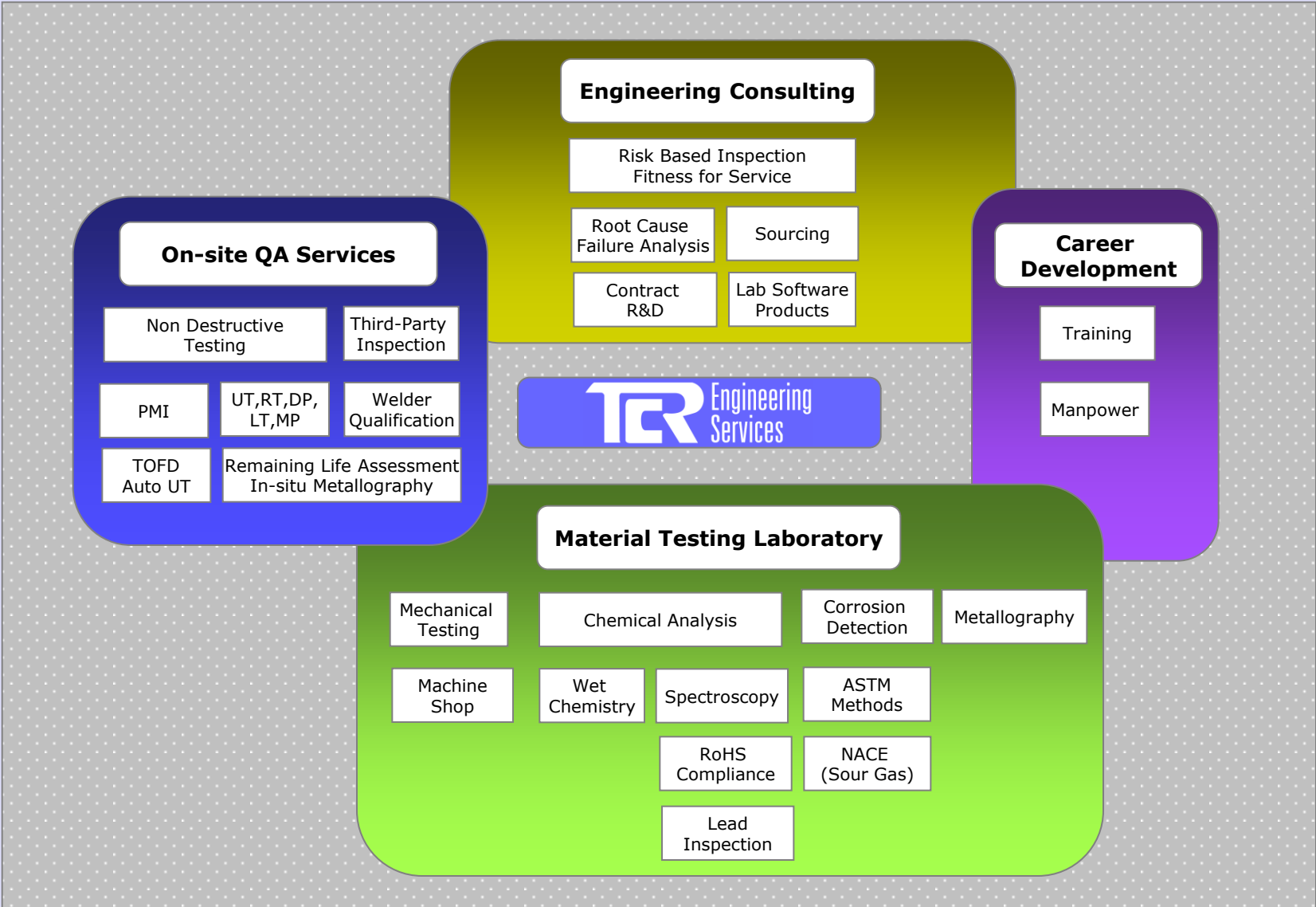


- **V.K. Bafna, Founder and Chairman, TCR Group**
 - Industry Expert with over 36 years of experience
 - ◆ Master of Engineering from University of Toronto, Canada
 - ◆ Master of Industrial Management from Clarkson College of Technology, New York
- **Paresh Haribhakti, Managing Director, TCR**
 - B.E. (Metallurgy), M.E. (Materials Technology) M.S. Univ. Baroda
- **Amit Bafna, Middle-East Operations Head**
 - 15 years of experience in Materials Engineering and Fabrication
- **Arjun Sail, General Manager (Mumbai)**
 - Project and Resource Management, Complete In-charge of Operations including the TCR Institute of Materials Technology
- **Jaidev Patel, NDT Department Head**
 - ASNT Level III (UT, MT), Metallography and RLA Expert
- **Rohit Bafna, Director Global Sales**
 - 18 years of technical sales and international marketing experience
 - B.S. in Computer Science from California, USA

Organization Chart– TCR Engineering (Mumbai)



Services Overview



Mechanical Testing

- Highly trained staff possesses extensive experience in engineering, mechanics, and materials science
- Comprehensive range of mechanical testing services
 - Tensile Testing including elevated temperature tests
 - ◆ UTM of 1000 KN capacity, UTM of 400 KN capacity and UTM of 30000 lbs capacity with Electronic Controls and Extensometers
 - Charpy Impact Test (weld and HAZ), Izod Impact Test
 - Fatigue Testing and CTOD
 - Weldability
 - Bend Test, Compression
 - Flaring / Flattening
 - Hardness Testing (Rockwell, Brinell, Superficial Micro Hardness)
 - Nick Break
 - Proof Load
 - Fasteners
 - Hydraulic / Pneumatic Test, Component Testing, and more.
- Fully equipped machine shop undertakes precision fabrication as per specification requirements.
 - CNC lathes, mills, stress-free grinding equipment, saws, surface grinders, and more.



Chemical Analysis

- State-of-the-Art Spectrometers and Wet Chemistry lab
 - Rapid, accurate analysis of individual & combined chemical elements
- Conducting analytical tests for Ferrous, Non Ferrous Metals, Ceramics, Glass, Refractories, Minerals and Ferro Alloys
 - Aluminum Alloys, Carbon, Low Alloy & Stainless Steels, Cobalt Alloys, Copper Alloys, Jewelry and Dental Alloys, Magnesium Alloys, Nickel Alloys, Superalloys, Titanium Alloys, Tool Steels, Zinc Alloys, Cast Iron, Weld Metals, Gases, Industrial Water and Process Solutions
- Classical Wet Chemistry using Gravimetry and Titrimetry procedures
- Analytical and interpretive expertise
 - Method development and validation, Identification of unknown materials



ARL Quantis
Optical Emissions Spectrometer



Glow Discharge
Spectrometer



Optical Emission
Spectrometer



Inductively Coupled Plasma
Spectrometer



Automatic
Carbon - Sulphur
Determination



Atomic Absorption
Spectrometer

Corrosion Testing

- Corrosion Testing for Sour Gas Applications

- NACE MR 0175 Testing
- Hydrogen-Induced Cracking Test (HIC) as per NACE TM 0284
- Sulfide Stress Corrosion Cracking Test (SSC) as per NACE TM 0177

- In-depth Corrosion Testing Facilities

- Inter-granular Corrosion Test (IGC) ASTM A262
 - ◆ Oxalic Acid Test, ASTM A262 Practice A (Oxalic Acid Etch)
 - ◆ Ferric Sulfate - Sulfuric Acid, ASTM A262 Practice B (Streicher Test)
 - ◆ Nitric Acid, ASTM A262 Practice C (Huey Test)
 - ◆ ASTM A262 Practice D (Modified Strauss Test)
 - ◆ Copper - Copper Sulfate - 16% sulfuric acid, ASTM A262 Practice E (Strauss)
 - ◆ Copper - Copper Sulfate - 50% sulfuric acid, ASTM A262 - Practice F
- Pitting Corrosion test as per ASTM G48 Specification
- Salt Spray Test per ASTM B117
- Chloride Stress Corrosion Test as per ASTM G36 Specification
- Corrosion test as per ASTM G35 specification
- Ammonia Vapor Test
- Corrosion test as per ASTM A761 Specification

- High Temperature (upto 250°C) and High Pressure (upto 200psi) Autoclaves



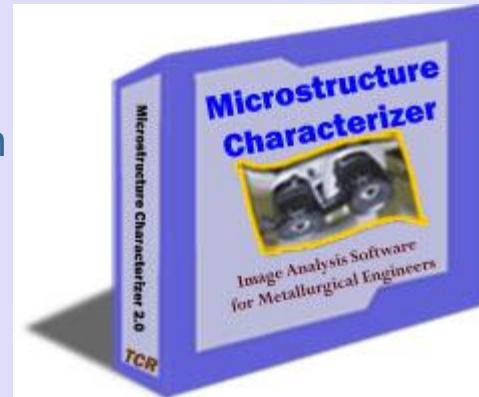
Proof Rings and High Pressure Autoclaves for NACE Tests

Metallography Studies

- SEM, EDAX, XRD, TEM and Inverted Metallurgical Microscopes
- Evaluate the characteristics of metals
 - Heat treatment condition, microstructure, forming process
 - Metallographic Preparation & Examination
 - Macro and Micro Examination
 - Micro Hardness Testing
 - Coating / Plating Evaluation (ASTM B487, ASTM B748)
 - Weld Examination , Case Depth and Decarburization Measurement
- In-house developed Microstructure Characterizer Software 3.0
 - Grain Size, Nodularity, Linear Measurements and more



Leco 500 Image Analysis System



MiC 2.0



Inverted Metallurgical Microscope

Failure and Root Cause Analysis

- Unravel the mysteries surrounding parts and assembly failures
- Strong Experience undertaking wide range of inspections
 - Residue Analysis
 - Corrosion Analyses/Studies
 - On-Site Investigations
 - Material Selection
 - Manufacturing Processes Evaluation
 - Welding Studies
 - Product Design Evaluation
 - Fractography
- Fast Turnaround time with in-depth analysis reporting
 - Strong Recommendations within each report to avoid future failures
- Strong History of Past Work, some examples:
 - Mandrel Bypass Of Equalizer Sub.
 - Crank Shaft
 - Cupro Nickel Tubing Of Chiller Unit
 - Shaft Failures In Vertical Pumps (Cantilever)
 - Volute Casing, Crane Hook / Pump
 - Die Cracking In Swaging Process on 500t Press
 - ESV Sleeve DN 200
 - Api 5L Line Pipe Failed During Hydro Test
 - Mechanical Expander Pull Rod
 - Blade Of LP Rotor Stage 4A Of ESM 110MW
 - Duplex Tube Failed During Hydro-Forming Expansion
 - Corrosion Evaluation Of Oil Well Tubing
 - Axel of a Rear Suspension of Car
 - Exhaust Muffler KTPA
 - Reformer Tubes
 - High Density Balancing Weight
 - Radiant Heater Outlet Header Cap
 - Crank Shaft Of Diesel Car Engine.
 - Notching Spring Of Tap Changer
 - Coriolis mass flow meter sensor
 - Re-Boiler of HF Recovery Plant
 - Bending and seizing problem of engine valve

Risk Based Inspection and FFS



- TCR and PP SIMTECH (UK) jointly promote Risk Based Inspection (API 580/581) and Fitness For Service (API 579) in India
 - RBI Experts conduct the RBI Team Study at plant site
 - rbiAsyst™ a software system developed by PP SIMTECH
 - ◆ Identify and resolve technical issues associated with static equipment including reactors, furnaces, strippers, distillation columns, heat exchangers, pressure vessels, reformers, boilers, fired heaters and items such as interconnected piping and storage tanks.
- Benefits of RBI
 - Increased safety and equipment reliability
 - Fewer planned shutdowns, Fewer unplanned shutdowns
 - Longer inspection intervals
 - Potential fewer inspection and maintenance costs
 - Evaluation of effectiveness of inspection activities
 - Increased consistency of inspection planning
 - Identification of potential damage mechanisms
 - Identification of key process parameters affecting degradation rates
 - Assessment of proposed process changes that could impact degradation rates
 - Documentation of current plant configuration and materials of construction
 - Improved team working and communication between all departments



Welder Certifications and WPQR

- Complete Services conducted by AWS/CSWIP Inspector
 - Welder Qualification Testing for performance qualification and certification of welders to ASME, ANSI, AWS, API code
 - Preparation of Weld Procedure Qualification per project requirements
 - Coupon Testing as per Weld Procedure Qualification
 - ◆ Includes visual examination, mechanical testing, metallographic examination and non destructive testing
 - Documentation of the Procedure Qualification Record as per ASME, ANSI, AWS, API codes
- In depth weld inspection to include review of the applicable qualification
 - ◆ Weld procedure specification, welder performance qualification and validity for process materials and consumable items, equipment, set up and other factors, including certificates of calibration and/or conformity governing the work.
 - ◆ Check safety of set up and operation having due regard for self, welder and other workers in vicinity, particular in respect of ultraviolet radiation from arc during welding.

Non Destructive Testing and PWHT Services

- Advanced and Conventional NDT services
 - In-Situ Metallography (Metallographic Replication) and Residual Life Assessment (RLA) of Boilers and pressure vessels
 - Ultrasonic Inspection
 - ◆ Time of Flight Diffraction and Ultrasonic Flaw Detection
 - ◆ Phased Array
 - ◆ Automated UT based Corrosion Mapping
 - Eddy Current Testing for Tube Inspection
 - Helium Leak Testing
 - Pigging using Radioisotopes for Leak Detection
 - Conventional NDT
 - ◆ Ultrasonic Examination using Pulse Echo, UT Thickness Measurement, Liquid Dye Penetrant Testing, Magnetic Particle Testing, WFMP, Visual Examination, Portable Hardness, Ferrite Measurement, PMI
- Post Weld Heat Treatment using 70 Kva Electric Resistance
- Complete Shutdown Management
 - Qualified Inspectors with ASNT Level II and III certifications, TKY, API, AWS/CSWIP, BGas, ASME, AWS, ASNT, NDT Project Managers
 - ◆ Available on a call-out basis or for long-term projects



NDT – TOFD, Flaw Detection, Ferrite Measurement

- Time of Flight (TOFD) Inspection
 - Amplitude independent accurate flaw sizing on a wide coverage area with extremely fast scanning



OmniScan MX from Olympus NDT



Fisher – MP30
Measurement of ferrite content in austenitic steel welds, normal construction steel with austenitic chrome alloy steel welded cladding (e.g., in boilers, vessels, etc.) and duplex steel



EPOCH LT – Ultrasonic Flaw Detection
Flaw detection in difficult field conditions or demanding production environments

Positive Material Identification



- On-site alloy verification
 - Portable X-Ray Florescence (XRF) Spectrometers
 - Portable Optical Emission Spectrometer (OES)
- Time and Material or fixed-cost engagements
 - Highly Mobile and Experienced Team
- 12 PMI instruments that can be deployed
 - Team TCR has provided PMI services to over 600 projects including major oil and petrochemical installations in India, Middle-East and Malaysia
- Services provided to Multiple Industry Verticals
 - Oil and Gas companies, Petrochemicals, Metal producers, Foundries, Metal Fabricators, Scrap yards, Scrap traders, Electric utility companies, Fossil and nuclear power plants, Refining and petrochemical industry, Construction Engineering, and the Chemical process industry



XMet 3000TX



Niton XLT



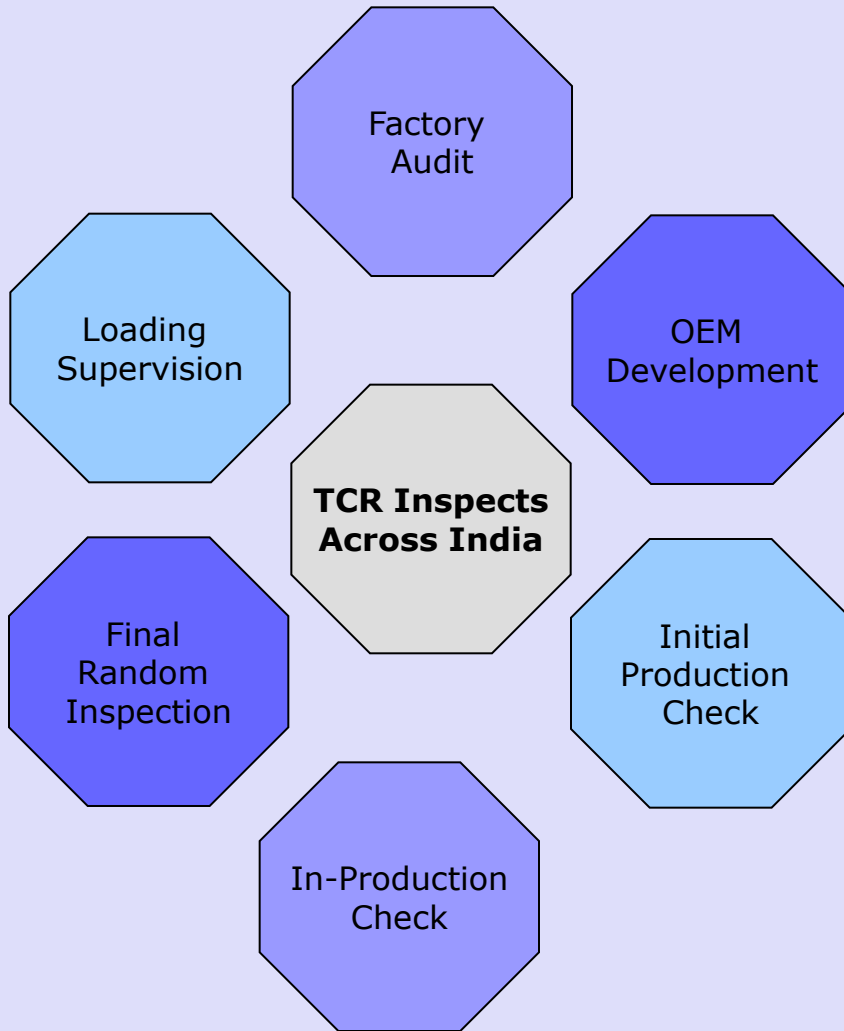
XMet 3000

RoHS Compliance Testing

- Restriction of Hazardous Substances
 - Detect the levels of lead, mercury, cadmium, hexavalent chromium, Br, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs) in electrical and electronic components
- Non-destructive, in-situ screening method for PVC, PE, alloys, metals, solders, ceramics and packaging materials
 - Simultaneously screen in a matter of seconds for all five restricted RoHS elements Hg, Cd, Cr, Br and Pb
- Verification Methods using ICP
- Expert and Highly Mobile Team
 - Deployment across India and rest of the World



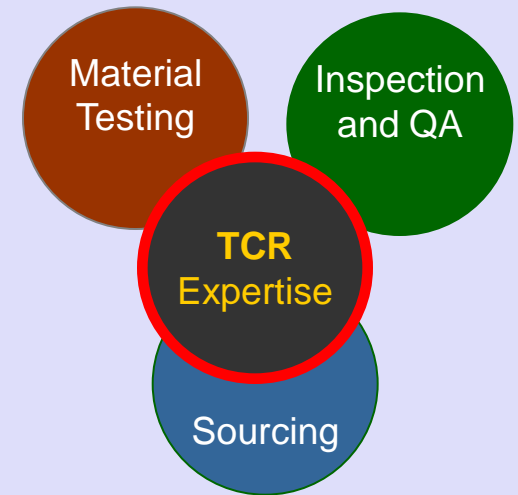
Inspection across India



- Independent, Third-Party Quality Assurance
 - Verifying the capability of a manufacturer to meet contract conditions
 - Assist in creating a first production prototype
 - Random and detailed visual inspection of products
 - Loading Supervision and Logistics Management
- Inspectors Travel across India
 - Defined Operations Procedure
- Testing Co-ordination
 - Samples picked by the inspection team are sent to TCR's Material Testing Lab

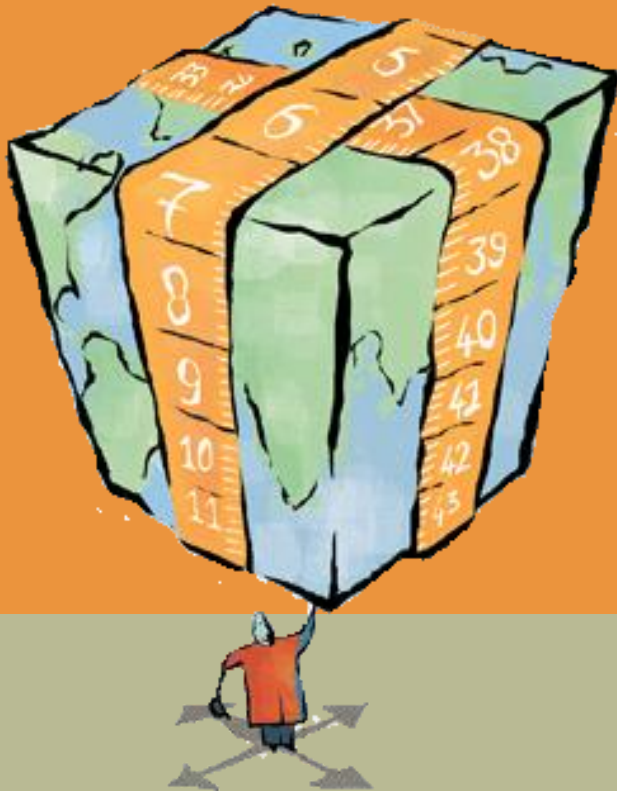
Product and Material Sourcing

- Leveraging Relationships with customers at the Lab
- Defined Sourcing Guidelines:
 - TCR initially seeks details on product type, drawing, material specifications, required amount and quality with target delivery date
 - Visiting the marketplace, contacting manufacturers, Customers of TCR, traders and steel producers, to establish production capability, availability, quality and unit price.
 - Providing a FOB product price quote. TCR directly negotiates with the supplier and provides a competitive bid.
 - If price and quality parameters are acceptable by the client, TCR instructs the manufacturer to produce an appropriate sample prototype for approval. The prototype is shipped to the client.
 - Once samples are approved, product order is placed with all manufacturing suppliers. Payment and shipping logistics are verified by TCR.



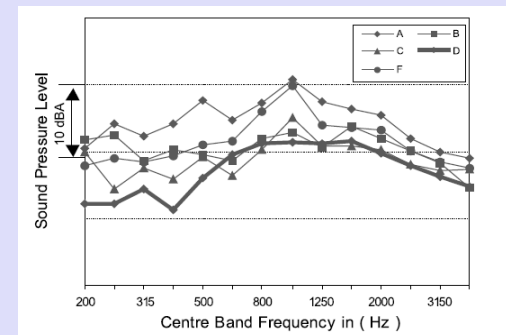
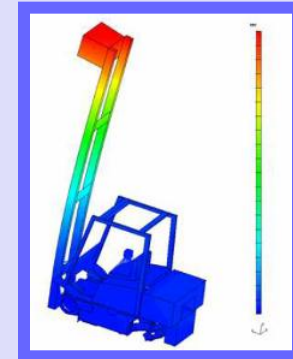
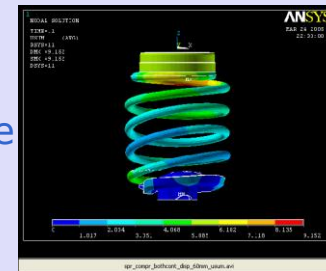
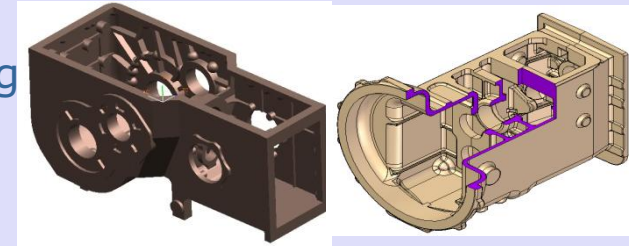
Engineering Consulting

- Experienced and competent staff is available for consultation
 - ◆ Comprehensive cost-effective solutions for challenging process and product problems
- Problems solved in areas of
 - Metallurgical Engineering
 - Corrosion Engineering
 - Welding Engineering
 - Castings and Forgings
 - Reverse Engineering, 2D to 3D
 - Mechanical Engineering
 - Heat Treatment
 - Forming and Casting
 - Materials Selection
- Training Seminars and Workshops



Engineering Design & Analysis Services

- Computer Aided Designing (CAD/CAM)
 - 2D to 3D Conversions, Solid Modeling, Surfacing for automotive, machinery and construction industries, Legacy Data Conversion for Material Handling Equipments
- Computer Aided Engineering (CAE) including Finite Element Modeling
 - FE stress analysis undertaken of
 - ◆ cylinder block, cylinder head, connecting rod
 - ◆ crankshaft & crankcase, shock absorber structure including outer tube, spring seat, knuckle etc
- Structural Analysis
- Noise, Vibration, Harshness (NVH) analysis
- Leading Software used
 - CATIA, Pro/ENGINEER, UniGraphics, I-DEAS, Inventor, SolidWorks, DELCAM, Ansys, LS Dyna, HyperMesh, NX Nastran, Moldflow



TCR Institute for Materials Technology



- Training students with our knowledge gained over the past 36 years in the material science industry
 - Training facility is equipped with latest technologies
- Training style is highly effective
 - Trainers are professionals in the technical education field
- “Coaching” approach to training
 - Hands-on Teaching with practical examples
- Long term accommodations available at a nearby hotel
- ASNT Level I and II Courses
 - Introduction to Metallography
 - Eddy Current Testing
 - Magnetic particle Testing
 - Liquid Penetrant Testing
 - Radiography
 - Ultrasonic Testing
 - Leak Testing
 - ToFD, Phased Array
 - Welder Certifications
- Custom Training Available
 - “On-Site” Classes are conducted all over the world
 - Minimum 4 students and a max of 10 students per class

Manpower Recruitment

- **Personnel available with strong experience**
 - Design, fabrication, construction, inspection and erection of Pressure Vessels, Heat Exchangers, Towers, Stacks, Tanks, Plant Pressure Piping, Offshore oil wells and many advanced projects
- **Highly Professional and Experienced**
 - ASNT Level III personnel with of 7-15 years
 - ASNT Level II personnel with 5-10 years
- **Fast Mobilization and Deployment**
 - ASNT Level II and III (MP, UT, RT, LP, VT)
 - AWS/CSWIP Senior Welding Inspector
 - API 510 and 570 Certified Inspectors
 - CSWIP Plant Inspector Level I (PL 11, PL 12)
 - Welding Inspector, Electrical Inspectors, Paint Inspectors
 - TKY Inspectors with UT Level II
 - Welders with 6G experience
- **Ready to work on projects across the globe**

Serving Local Markets

TCR Engineering Services Pvt. Ltd.

Plot No. EL-182, MIDC-TTC, Electronic Zone,
Behind Nelco, Mhape, Navi Mumbai-400 710
Tel: +91-22-67380900 to 999
Fax: +91-22-27612044
E-Mail: sales@tcreng.com

TCR Engineering Consulting FZC

PO Box 122453, Dubai, UAE
Tel: +971-7858901
E-Mail: uae@tcreng.com

TCR Advanced Engineering

36/2/9, First Floor, Abhishek Complex
G.I.D.C., Makarpura, Vadodara - 390 010
Tel: +91-(0265)-2657233, 2643024
Fax: +91-(0265)-2634375
E-Mail: baroda@tcreng.com

TCR World Inc. USA

2657-G Annapolis Road, Suite 136
Hanover, MD 21076, USA
Tel: +1-301-996-0111
E-Mail: usa@tcreng.com

TCR Arabia Llc.

P.O. Box 3422
3 & 4, next to Al Kifah Construction
besides Al-Kadi Tent Factory
near King Abdulaziz Sea Port
Dammam, Kingdom of Saudi Arabia
Tel: +966-3-8475784 / 85, +966-3-8475014
Cell: +966-5-0499-7683 | Fax: +966-3-8475768
sales@tcr-arabia.com | www.tcr-arabia.com

TCR Kuwait

Fahaheel-64023, Kuwait
Tel: +965-23910341, +965-23910345
Cell: +965-65072765
Fax: +965-23910340
kuwait@tcreng.com | www.tcr-kuwait.com

TCR Africa (Pty) Ltd.

120 Tulip Gardens, Shamrock Road, Vorna Valley,
Midrand, Johannesburg, 1685
Republic of South Africa
Mobile: +27 71 440 5741
Fax: +27 86 663 1644

Summary

- Experience Gained with Global Reach
- We focus on end-to-end Quality Assurance
 - Core competency in Material Testing & NDT Services
 - Material Inspection across India
 - Research Oriented Failure Analysis and RBI Studies
- Deep understanding of Client's end applications
 - Listening closely and documenting each communication
- Industry leading Customer Service
 - Laboratory Information Management System
 - Professional, courteous and building relationships
- Nimble and flexible, driven by quality and processes
 - Supported by "best practice" processes
 - ◆ NABL, BIS and ISO 17025 quality standards





Questions?

Email: pr@tcreng.com