SAUDI ARAMCO

MECHANICAL ENGINEER & SUPERVISOR

ARAMCO APPROVAL EXAM PREPARATION GUIDE

Document	Mechanical Engineer & Supervisor — Aramco Approval Exam Preparation Guide
Topics	Pressure Vessels · Piping Systems · Rotating Equipment · Welding & NDT · Lifting & Rigging · Maintenance Systems
Reference Standards	ASME VIII, ASME B31.3, API 510, API 570, API 653, API 686, Saudi Aramco SAES, Saudi Labour Law
Level	Mechanical Engineer / Mechanical Supervisor / Equipment Inspector
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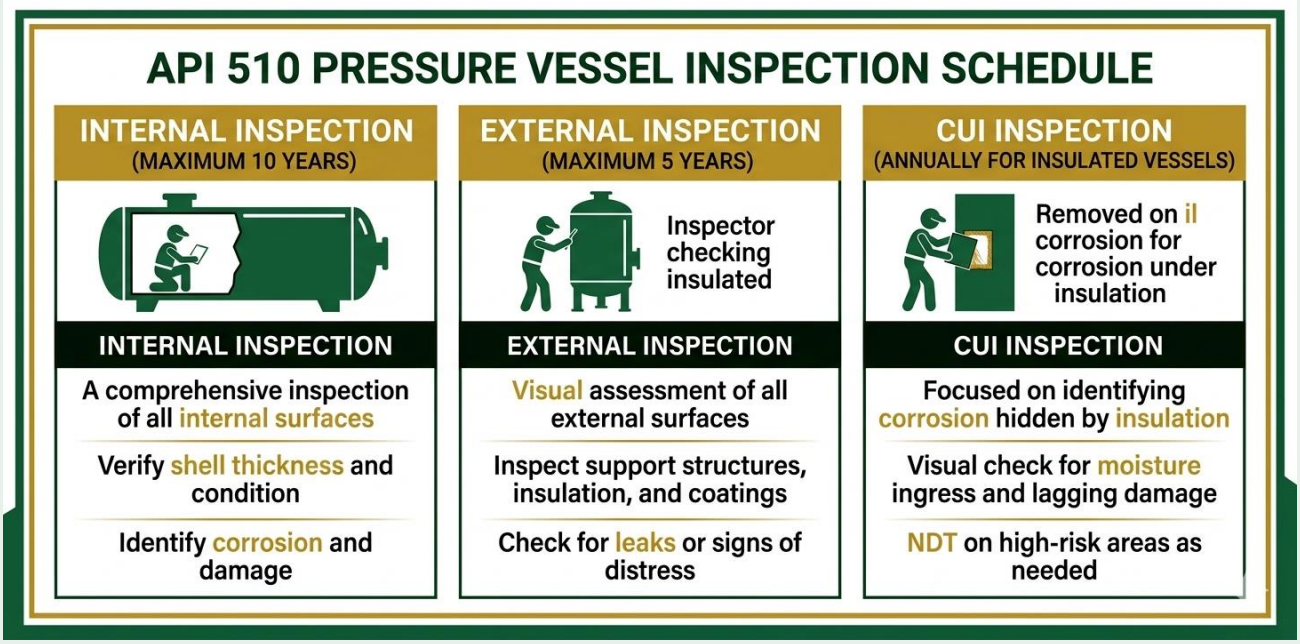
HOW TO USE THIS GUIDE

This guide is written for engineers and supervisors preparing for the Saudi Aramco Mechanical Engineer or Mechanical Supervisor Approval examination. It covers the six core technical areas tested in the Aramco mechanical approval process, followed by 200 exam questions with a full answer key.

Section	Content
Part 1 — Pressure Vessels	Design principles, inspection, ASME VIII, API 510, corrosion, fitness for service
Part 2 — Piping Systems	Pipe classes, ASME B31.3, API 570, stress analysis, pressure testing, piping inspection
Part 3 — Rotating Equipment	Pumps, compressors, turbines, alignment, vibration, API 686 commissioning
Part 4 — Welding & NDT	Weld processes, ASME IX, WPS/PQR, NDT methods, defect acceptance criteria
Part 5 — Lifting & Rigging	Crane operations, rigging hardware, load calculations, Aramco lifting standards
Part 6 — Maintenance Systems	Preventive, predictive, corrective maintenance, RBI, CMMS, Aramco standards
Part 7 — 200 Exam Questions	9 topic areas, A/B/C options, answer key on last page only
Passing Score	Aim for 180+/200 (90%) before sitting the real exam

PART 1 — PRESSURE VESSELS



1.1 What Is a Pressure Vessel?

A pressure vessel is any closed container designed to hold gases or liquids at a pressure substantially different from ambient pressure. On Saudi Aramco projects, pressure vessels are designed, fabricated, inspected, and maintained to strict international standards — primarily ASME Boiler and Pressure Vessel Code Section VIII, supplemented by Aramco engineering standards (SAES).

The consequence of pressure vessel failure is catastrophic. Stored energy in a pressurised vessel releases explosively on rupture. Understanding the design, inspection, and fitness-for-service principles governing pressure vessels is a core competency for every Aramco mechanical engineer and supervisor.

1.2 ASME VIII — Design Fundamentals

ASME Section VIII is divided into three divisions based on design pressure and method:

Division	Scope	Key Method	Max Pressure
Div 1	Most industrial vessels	Design by formula — simplified rules	3,000 psi
Div 2	Higher pressure, critical service	Design by analysis — more rigorous	10,000 psi
Div 3	Very high pressure service	Alternative rules for ultra-high pressure	>10,000 psi

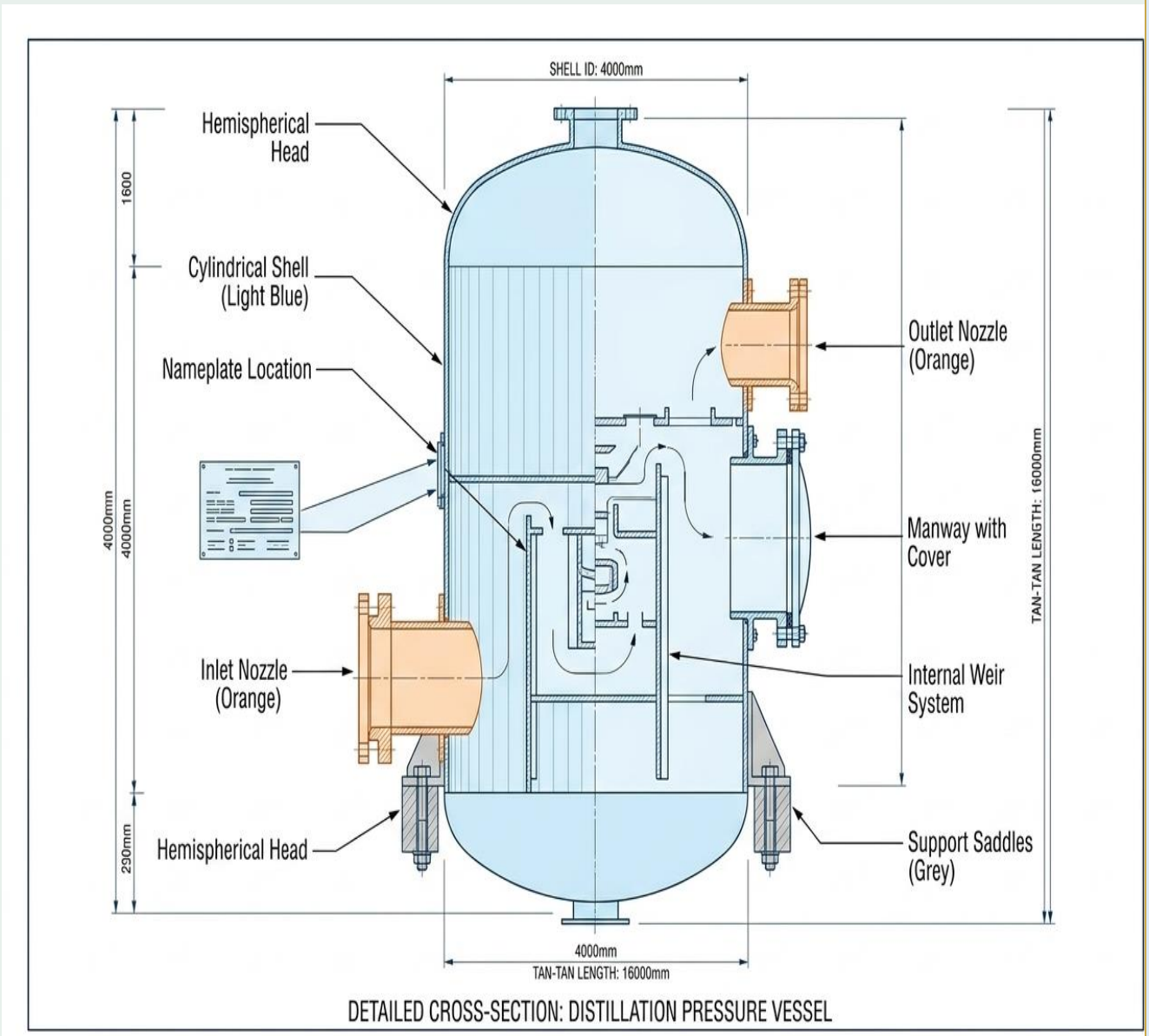
Key Design Formula — Shell Thickness (Cylindrical Shell, ASME VIII Div 1)

t = PR / (SE - 0.6P)

Where: t = minimum required thickness (inches) | P = internal design pressure (psi) | R = inside radius (inches) | S = allowable stress value of material (psi) | E = joint efficiency factor (1.0 for full radiography)

EXAM CRITICAL: Know the variables. The most common exam question asks what happens to required wall thickness when pressure doubles — it doubles. When radius doubles — it doubles. When allowable stress doubles — thickness halves.

1.3 Pressure Vessel Components



Component	Function and Key Points
Shell	Primary pressure-containing envelope — cylindrical in most vessels. Wall thickness calculated by ASME formula.
Heads	Close the ends of the shell. Types: ellipsoidal (2:1 ratio — most common), hemispherical (thinnest wall required), flat (heaviest — avoid for pressure service), conical, torispherical (Klopper/Korbbogen).
Nozzles	Openings for process connections, instruments, and manways. Must be reinforced — material removed by opening is replaced by reinforcement pad or increased nozzle wall thickness.
Flanges	Bolted connections. ASME B16.5 governs flange class ratings (150, 300, 600, 900, 1500, 2500). Higher class = higher pressure rating.
Supports	Skirts (vertical vessels), saddles (horizontal vessels), legs, lugs. Must be designed for vessel weight, wind, seismic, and nozzle loads.
Nameplate	ASME Code stamp (U stamp). Records MAWP, design temperature, material, year of manufacture, and manufacturer. Must never be removed or obscured.

1.4 API 510 — Pressure Vessel Inspection

API 510 governs the in-service inspection, rating, repair, and alteration of pressure vessels. Every Aramco mechanical engineer must know API 510 in detail.

Inspection Intervals — API 510

Inspection Type	Maximum Interval	Key Requirement
External Inspection	5 years	Visual check of external condition, insulation, supports, corrosion, leakage
Internal Inspection	10 years (or half remaining life — whichever is less)	Internal visual and UT thickness measurement; corrosion assessment
Pressure Test (on alteration or repair)	After every repair or alteration	Hydrostatic test at 1.3x MAWP (ASME VIII); pneumatic test at 1.1x MAWP where hydro not practical

Corrosion Rate and Remaining Life Calculation — API 510

Corrosion Rate (mpy) = (Previous thickness - Current thickness) / Years between inspections

Remaining Life (years) = (Current thickness - Minimum required thickness) / Corrosion rate

Next Inspection Interval = Remaining life / 2 (not to exceed API 510 maximum)

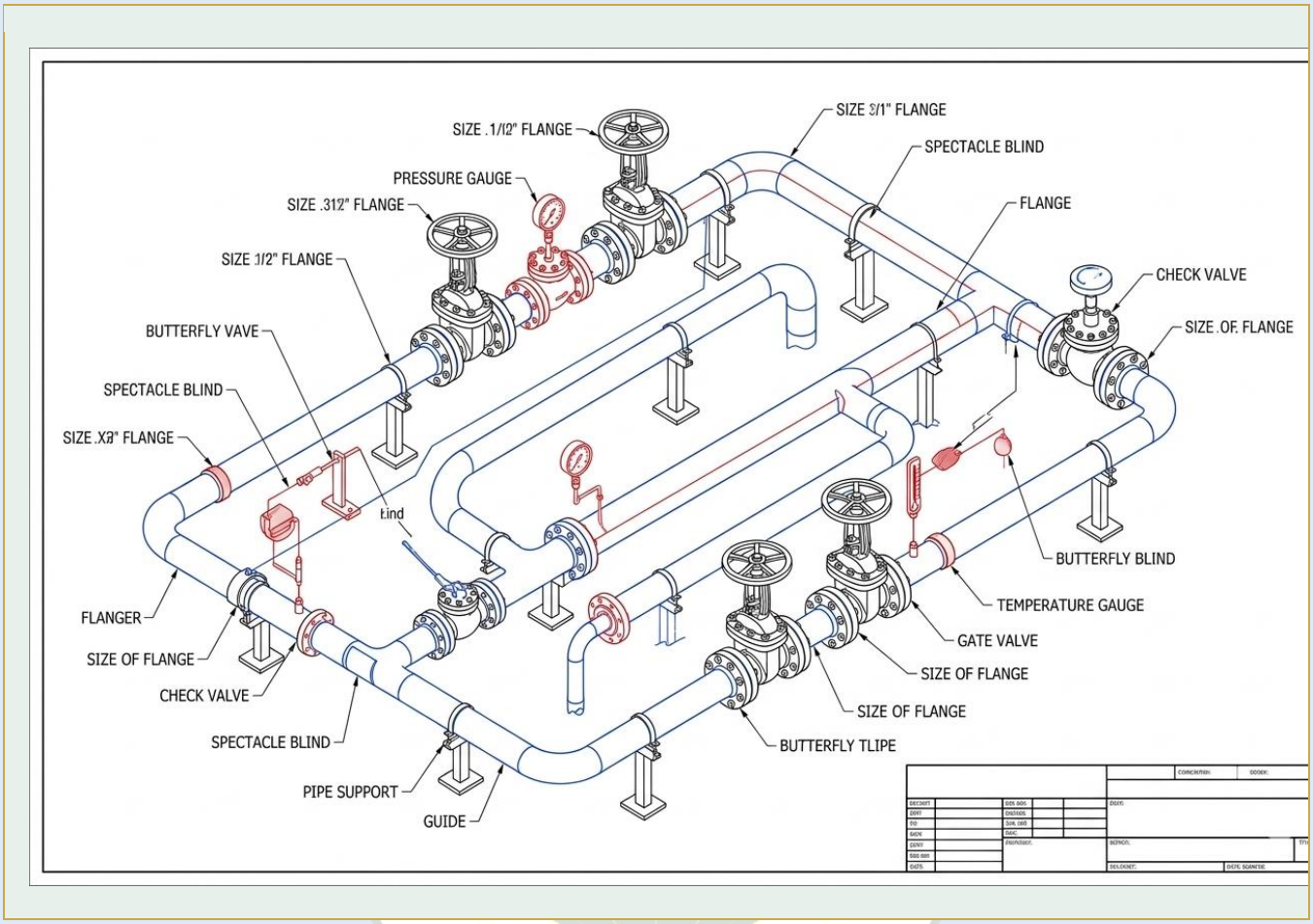
EXAM CRITICAL: This calculation appears in almost every Aramco mechanical exam. Practise it until you can do it without thinking.

1.5 Fitness for Service — API 579

When an in-service vessel has degradation (corrosion, cracks, dents, weld defects), API 579 provides a structured methodology to assess whether the vessel can continue to operate safely at current or reduced conditions — without requiring immediate repair or replacement.

Three levels of assessment: Level 1 (conservative, simple screening), Level 2 (detailed engineering analysis), Level 3 (advanced analysis — finite element, fracture mechanics). Most field assessments start at Level 1.

PART 2 — PIPING SYSTEMS



2.1 Piping Design Standards

Piping systems on Saudi Aramco projects are governed primarily by ASME B31.3 Process Piping. Other codes apply to specific services:

Code	Title	Application
ASME B31.3	Process Piping	Refineries, petrochemical, chemical plants — most common Aramco application
ASME B31.1	Power Piping	Steam systems, boilers, power generation
ASME B31.4	Pipeline Transportation (Liquid)	Crude oil and liquid hydrocarbon pipelines
ASME B31.8	Gas Transmission and Distribution	Natural gas pipelines
API 570	Piping Inspection Code	In-service inspection of process piping — inspection intervals, corrosion assessment

2.2 Pipe Classification — Schedule and Wall Thickness

Pipe wall thickness is defined by Schedule number. Higher schedule = thicker wall = higher pressure rating. Common schedules: Sch 40 (standard), Sch 80 (extra strong), Sch 160, Sch XXS (double extra strong).

Pipe size is defined by Nominal Pipe Size (NPS) — a dimensionless designator. The actual outside diameter (OD) does not equal the NPS for sizes below NPS 14. For NPS 14 and above, OD equals NPS in inches.

2.3 Piping Components

Component	Key Engineering Points
Valves	Gate (isolation, not throttling), Globe (throttling, high pressure drop), Ball (quick isolation, quarter turn), Butterfly (large bore isolation), Check (prevent backflow), Control (automated flow regulation)
Flanges	ASME B16.5 classes: 150, 300, 600, 900, 1500, 2500. Facing types: Raised Face (RF), Flat Face (FF), Ring Type Joint (RTJ — high pressure/temperature). Never connect RF to FF without design review.
Gaskets	Spiral wound (most common in process piping), Ring joint (RTJ flanges), Full face (FF flanges only), Sheet gasket (low pressure). Gasket material must match fluid service.
Fittings	Elbows (90°, 45°, LR, SR), Tees (equal, reducing), Reducers (concentric, eccentric), Caps, Couplings. Long radius (LR) elbows preferred — lower pressure drop.
Expansion Loops / Bellows	Absorb thermal expansion in piping. Expansion loops preferred over expansion joints for process piping — more reliable. Anchor points and guides required.

2.4 API 570 — Piping Inspection

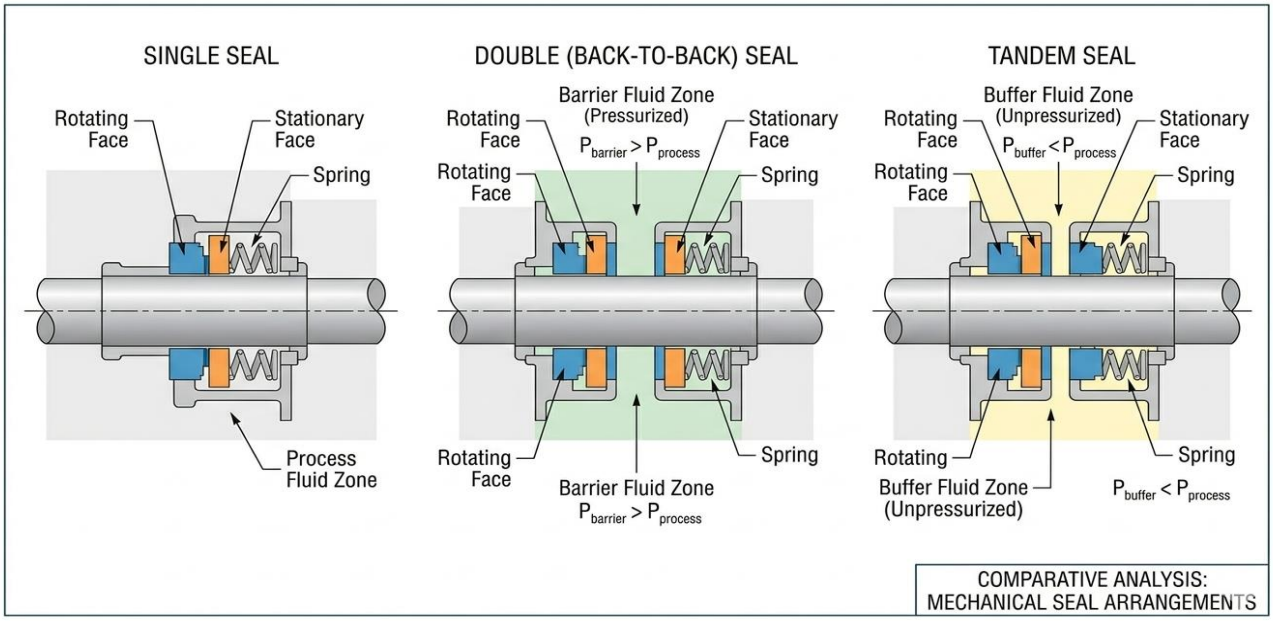
Piping Circuit Classification and Inspection Intervals

Class	Service Examples	External Inspection	UT Thickness
Class 1	H2S, HF acid, lethal, high-pressure steam	5 years	5 years
Class 2	Most hydrocarbon services	5 years	10 years
Class 3	Non-flammable, non-toxic, low pressure	5 years	10 years

2.5 Pressure Testing of Piping — ASME B31.3

Test Type	Test Pressure	Hold Time / Acceptance
Hydrostatic	1.5 × design pressure × (cold allowable stress / hot allowable stress)	Minimum 10 minutes; no pressure drop; no visible leakage
Pneumatic	1.1 × design pressure	Gradually increase to 50% test pressure, then in 10% steps; hold 10 minutes at test pressure; no leakage
Leak Test (sensitive)	Per design — typically operating pressure	Bubble solution, detector fluid, or halide method; zero leakage

PART 3 — ROTATING EQUIPMENT



3.1 Centrifugal Pumps

Centrifugal pumps are the most common rotating equipment on Aramco facilities. They transfer energy from a rotating impeller to the fluid, creating velocity (kinetic energy) that is converted to pressure (potential energy) in the volute or diffuser.

Key Pump Performance Parameters

Parameter	Definition	Exam Key Point
Flow Rate (Q)	Volume of fluid moved per unit time (m^3/h or GPM)	Increases as head decreases along the pump curve
Total Head (H)	Total energy added to fluid per unit weight (metres or feet)	Decreases as flow increases along the pump curve
NPSH Available (NPSHa)	Net positive suction head available at pump inlet — determined by system	Must always exceed NPSHr (required) — margin of minimum 1 metre
NPSH Required (NPSHr)	Minimum suction energy required to prevent cavitation — determined by pump design	Pump cavitates when NPSHa < NPSHr — causes noise, vibration, impeller damage
Best Efficiency Point (BEP)	Operating point where hydraulic efficiency is maximum	Pumps should operate within 70-120% of BEP flow; outside this range — reliability suffers
Specific Speed (Ns)	Dimensionless parameter characterising impeller type	Low Ns = radial flow impeller; High Ns = axial flow impeller

3.2 Cavitation — Cause, Detection, Consequences

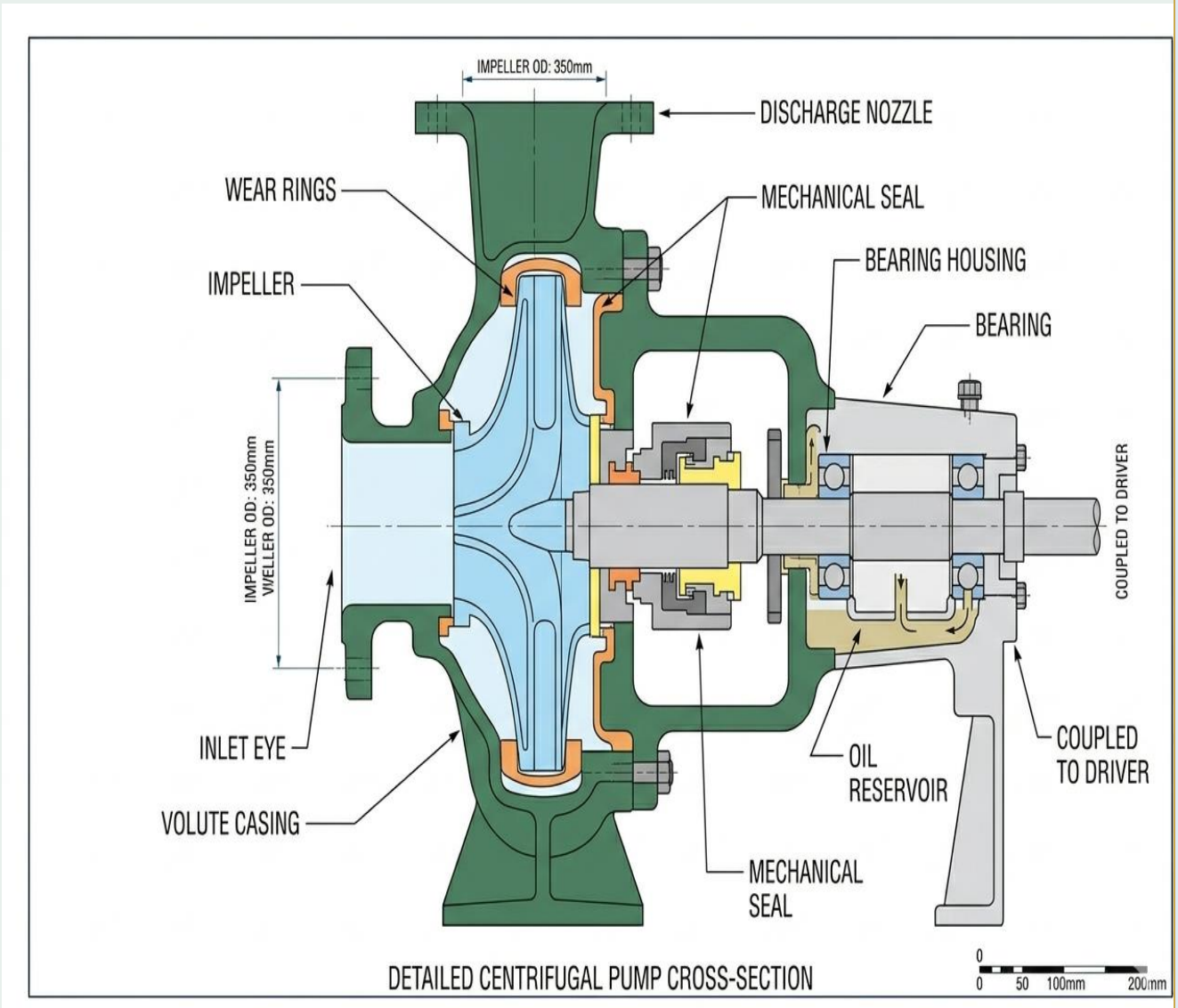
Cavitation occurs when local fluid pressure drops below vapour pressure, forming vapour bubbles. When these bubbles collapse (implode) as they enter higher-pressure zones, they release intense local energy, causing:

- Noise — characteristic crackling or gravel sound from pump
- Vibration — erratic pump operation, bearing loading
- Impeller damage — pitting and erosion of impeller blades
- Performance deterioration — flow and head drop below pump curve

Prevention: ensure NPSHa exceeds NPSHr with adequate margin; maintain suction pressure; avoid excessive flow rates; reduce fluid temperature where possible.

3.3 Pump Alignment — API 686

API RP 686 (Machinery Installation and Installation Design) governs the installation and alignment of rotating equipment on Aramco projects. Shaft misalignment is the leading cause of premature bearing and seal failure on rotating equipment.



Misalignment Type	Description	Consequence
Angular	Centrelines of shafts meet at an angle — not parallel	Cyclical bending of coupling and shafts — fatigue failure
Parallel (Offset)	Shaft centrelines are parallel but offset — not collinear	Lateral forces on bearings — accelerated wear
Combined	Both angular and parallel misalignment present simultaneously — most common in practice	Worst case — maximum mechanical stress on all components

3.4 Compressors

Compressors increase gas pressure through mechanical work. Two fundamental types:

Dynamic Compressors (Centrifugal and Axial)

Add velocity to gas through rotating impellers; velocity converted to pressure in diffuser. Continuous flow. Sensitive to molecular weight changes — performance changes with gas composition. Subject to surge (unstable operation at low flow — must be avoided).

Positive Displacement Compressors (Reciprocating and Screw)

Trap fixed volumes of gas and compress by reducing volume. Flow is pulsating (reciprocating). Less sensitive to gas composition changes. Reciprocating compressors require pulsation dampeners on suction and discharge.

Surge — The Critical Compressor Hazard

Surge occurs in dynamic compressors when flow drops below the minimum stable flow — the compressor can no longer maintain discharge pressure. Gas flow reverses violently through the compressor. Consequences: severe vibration, bearing damage, seal failure, and potential catastrophic failure. Anti-surge control systems are mandatory on all centrifugal compressors.

3.5 Vibration Analysis

Vibration monitoring is the primary predictive maintenance tool for rotating equipment. ISO 10816 defines acceptable vibration limits. Key vibration frequencies and their causes:

Vibration Frequency	Most Likely Cause	Corrective Action
1× Running Speed	Unbalance — most common cause of vibration	Dynamic balancing of rotor
2× Running Speed	Misalignment (angular) or looseness	Realignment; check foundation bolts
Sub-synchronous (<1×)	Oil whirl / oil whip in journal bearings; surge in compressors	Bearing design review; anti-surge control
High frequency (multiple×)	Rolling element bearing defects; gear mesh	Bearing replacement; gear inspection

PART 4 — WELDING AND NON-DESTRUCTIVE TESTING (NDT)

4.1 Welding Processes

Process	Code	Application	Key Characteristics
SMAW	111	General structural, pipe, vessels	Most versatile; can weld in all positions; slag removal required; sensitive to moisture in electrodes
GTAW (TIG)	141	Root passes in pipe, stainless, alloy	Highest quality; slow; no filler or external filler wire; inert gas shield; essential for corrosion-resistant alloys
GMAW (MIG)	135/136	Structural, fabrication shop	High deposition rate; continuous wire feed; not ideal for site welding in wind
FCAW	136	Structural, heavy fabrication	Higher deposition than SMAW; flux-cored wire; can be self-shielded (site use) or gas-shielded
SAW	121	Long seams in vessels and pipelines	Submerged under flux; highest deposition rate; flat position only; excellent for thick wall vessels

4.2 Welding Qualification — ASME Section IX

ASME Section IX governs the qualification of welding procedures (WPS/PQR) and welders (WQT) for all ASME-coded work. Every weld on a Saudi Aramco pressure vessel or piping system must be made by a qualified welder using a qualified procedure.

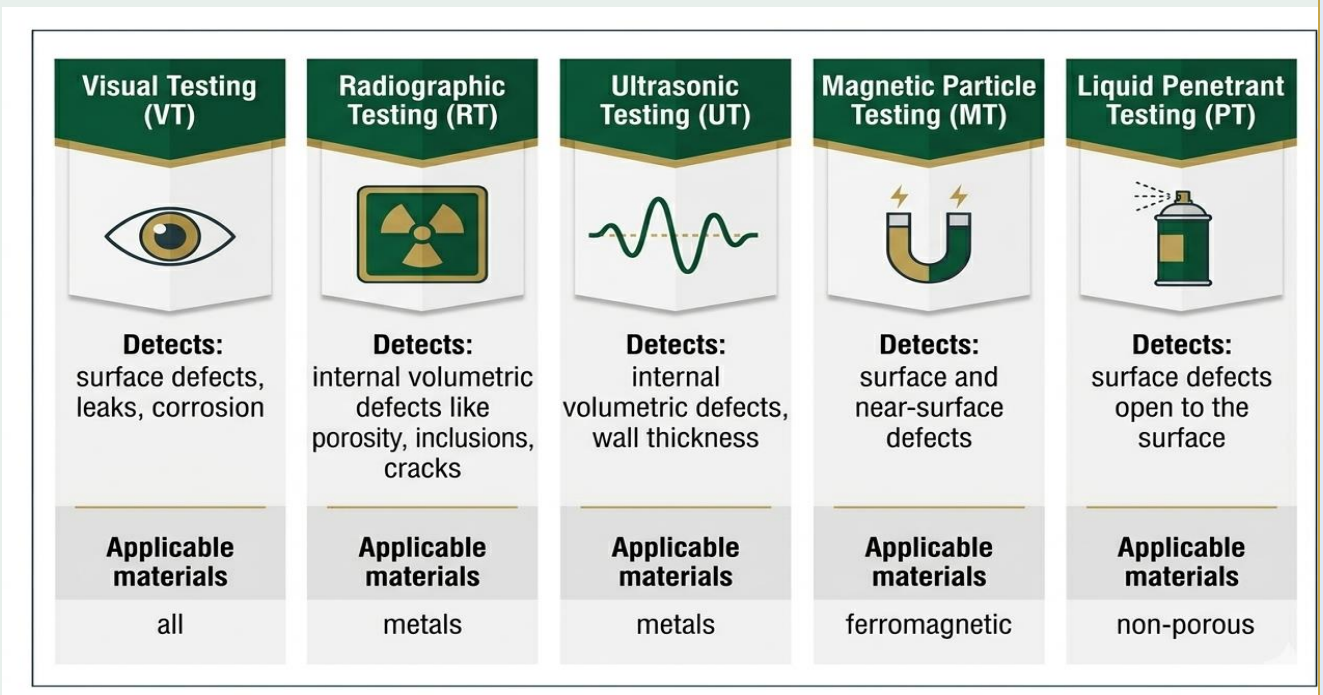
Document	What It Is	Who Approves
WPS	Welding Procedure Specification — the written instruction telling the welder how to make the weld (process, filler, preheat, interpass temp, current, travel speed, position)	Manufacturer/contractor — supported by PQR
PQR	Procedure Qualification Record — the test record that proves the WPS produces acceptable welds (destructive and non-destructive test results)	Manufacturer/contractor — test results signed by authorised inspector
WQT	Welder Qualification Test — proves the individual welder can apply the WPS correctly (performance qualification)	Welder tested by manufacturer; results signed by authorised inspector

4.3 Essential Variables — ASME IX

Essential variables are welding parameters whose change requires a new PQR to be conducted. Non-essential variables can be changed within the WPS without re-qualification. Supplementary essential variables apply only when Charpy impact testing is required.

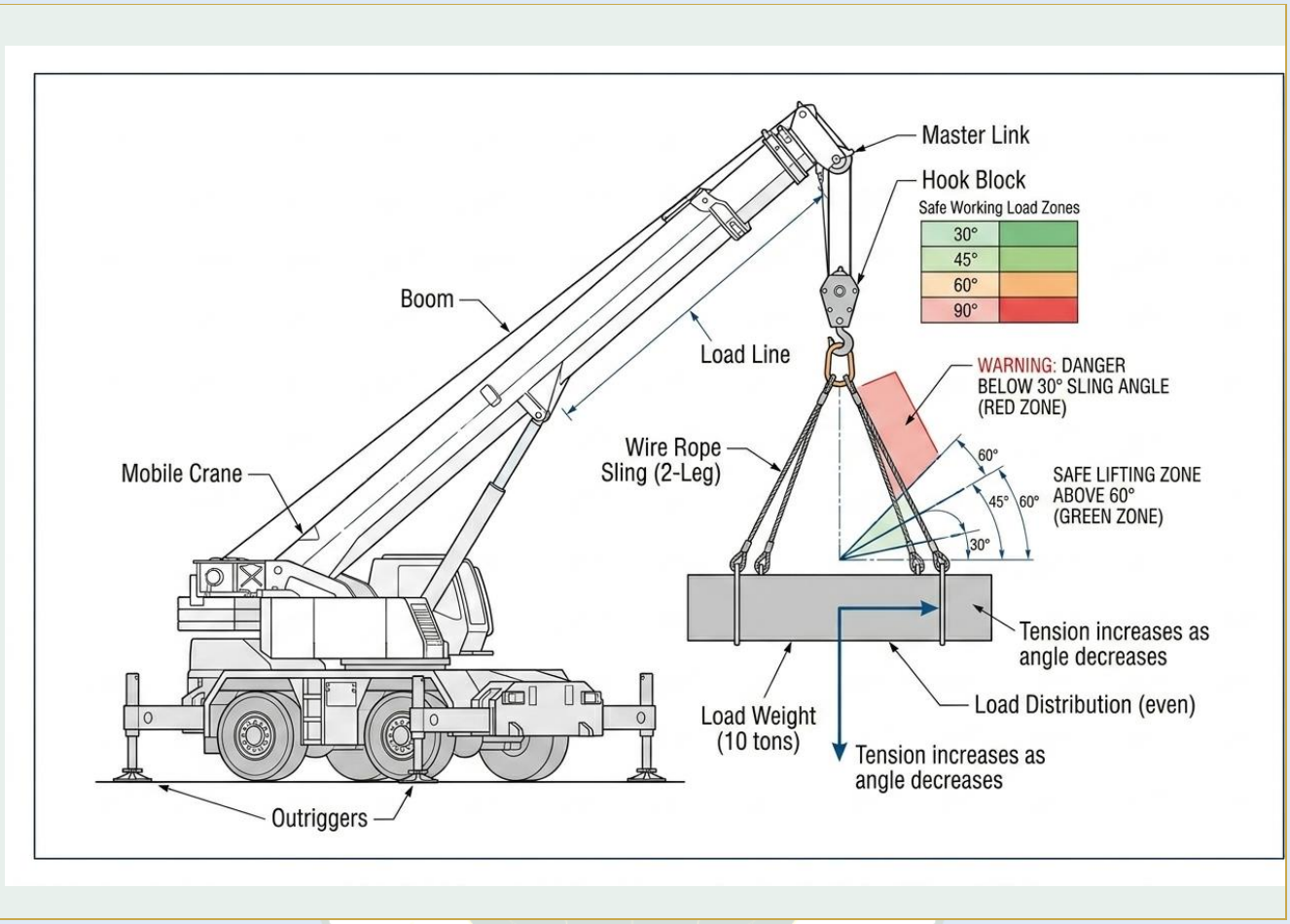
Key essential variables (SMAW): base metal P-number change, filler metal F-number change, change from one P-number group to another, removal of PWHT, change in position beyond qualification, change in backing.

4.4 Non-Destructive Testing Methods



Method	Code	Detects	Cannot Detect	Key Requirement
Visual Testing	VT	Surface discontinuities, dimensional defects, profile	Subsurface defects	Adequate lighting (500 lux minimum); CWI qualified inspector
Liquid Penetrant	PT / LPT	Surface-breaking defects on non-porous materials	Subsurface defects; porous materials	Surface must be clean; dwell time per specification; ASME V Article 6
Magnetic Particle	MT / MPI	Surface and near-surface defects in ferromagnetic materials	Non-magnetic materials (austenitic SS, aluminum)	Material must be ferromagnetic; ASME V Article 7
Ultrasonic Testing	UT	Subsurface volumetric defects, wall thickness measurement	Near-surface dead zone; complex geometry	Couplant required; calibration to reference standard; ASME V Article 4/5
Radiography	RT	Volumetric defects (porosity, inclusions, cracks in film plane)	Laminar defects parallel to beam; tight cracks	Radiation safety controls; exclusion zone; ASME V Article 2; film density 2.0-4.0
PAUT / TOFD	UT (Advanced)	Volumetric and planar defects with high accuracy; weld examination alternative to RT	Requires calibration blocks and qualified operator	Increasingly replacing RT on Aramco projects; requires written procedure and qualification

PART 5 — LIFTING AND RIGGING



5.1 Lifting Standards on Saudi Aramco Projects

Lifting operations on Saudi Aramco projects are governed by GI-0002.102 (Lifting and Hoisting) and supplemented by ASME B30 standards. All lifts require a formal Lifting Plan. Critical lifts require additional engineering review and approval before execution.

Lift Classification

Lift Type	Definition	Required Controls
Routine Lift	Load <75% of crane rated capacity; no special conditions	Lifting plan; qualified rigger; operator certification; pre-lift inspection
Critical Lift	Load >75% of crane capacity; near power lines; over live process; tandem crane lift; personnel lift	Engineer-approved lifting plan; rigger Level 2+; Lifting Supervisor; exclusion zone; pre-lift meeting
Super Critical Lift	>90% crane capacity; abnormal load path; multiple cranes with complex rigging	Aramco Lifting Authority approval; third party review; dedicated Lift Director

5.2 Rigging Hardware — Working Load Limits

Every piece of rigging hardware has a Working Load Limit (WLL) — the maximum load it may carry in service. The WLL is based on the Minimum Breaking Force (MBF) divided by a safety factor. Never use rigging hardware beyond its WLL.

Hardware	Safety Factor	Key Inspection Point	Rejection Criteria
Wire Rope Slings	5:1	Broken wires, kinks, corrosion, core damage	10 random broken wires per lay; kinking or crushing
Chain Slings	4:1	Stretch, cracks, gouges, weld damage	>3% stretch of original length; any crack; link deformation
Web (Textile) Slings	5:1 (polyester)	Cuts, tears, chemical damage, UV degradation	Any cut through to load-bearing fibres; chemical staining; heat damage
Shackles	5:1 (alloy) / 6:1	Pin security, body cracks, corrosion, deformation	Missing or incorrect pin; any crack or deformation
Hooks	5:1	Throat opening, latch, twist, cracks	>5% increase in throat opening; missing latch; visible cracks

5.3 Sling Angles and Load Effect

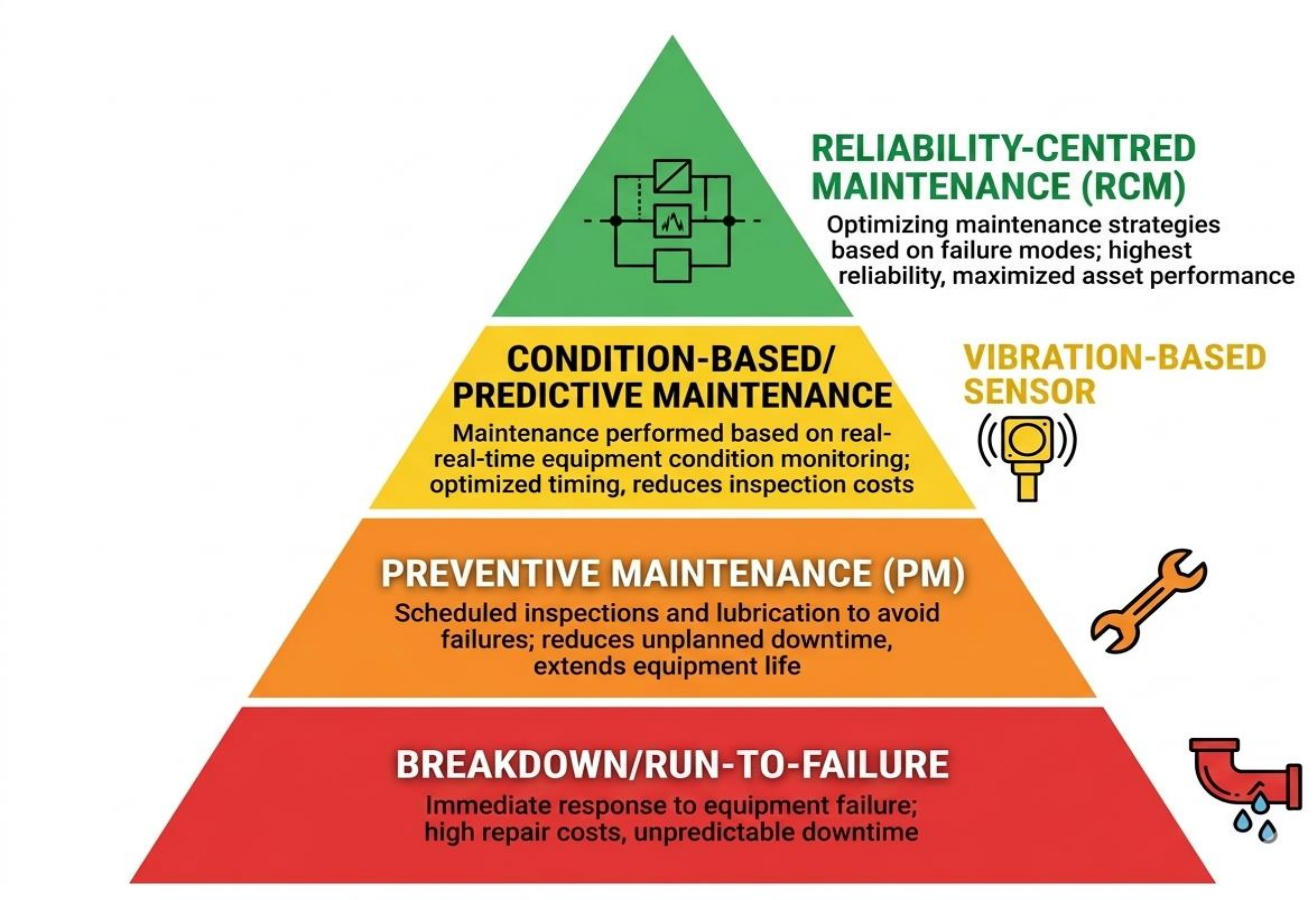
The angle of a sling to the vertical directly affects the tension in the sling. As the sling angle decreases (sling becomes more horizontal), the tension in each sling leg increases dramatically for the same load.

EXAM CRITICAL: At 30 degrees from vertical, each sling leg carries 2.0 times the load it would carry at 90 degrees. Minimum sling angle is 45 degrees from horizontal on Aramco projects. Never use sling angles below 30 degrees from vertical.

5.4 Centre of Gravity and Load Balance

The centre of gravity (CoG) of the load must be determined before rigging. If the rigging attachment point is not directly above the CoG, the load will tilt when lifted. For asymmetric loads, rigging calculations must account for the actual CoG location to determine individual sling leg tensions.

PART 6 — MAINTENANCE SYSTEMS



6.1 Maintenance Strategy Types

Strategy	Description	Best Applied To
Run-to-Failure (RTF)	No planned maintenance — allow equipment to fail and then repair. Lowest cost only when failure consequences are low.	Non-critical, low-consequence, easily replaced equipment with spare in stock
Preventive Maintenance (PM)	Scheduled maintenance at fixed intervals regardless of equipment condition. Time-based or usage-based.	Equipment where failure mode is time/wear related; safety-critical equipment with defined service life
Predictive Maintenance (PdM)	Maintenance triggered by actual equipment condition — using monitoring techniques (vibration, thermography, oil analysis, ultrasound) to detect developing failure.	Rotating equipment, electrical equipment, high-value assets where failure develops gradually
Reliability-Centred Maintenance (RCM)	Structured analysis to determine the most effective maintenance strategy for each failure mode of each critical asset. Used to optimise maintenance programmes.	Complex critical systems; greenfield plant design; maintenance programme optimisation

6.2 Risk-Based Inspection (RBI) — API 580/581

Risk-Based Inspection is the methodology used on Saudi Aramco projects to prioritise inspection resources based on the risk posed by each piece of equipment. Risk = Probability of Failure × Consequence of Failure.

Equipment with high consequence of failure (toxic release, fire, explosion) and high probability of failure (active corrosion, old age, poor history) receives the most frequent and thorough inspection. Equipment with low risk can have inspection intervals extended — freeing resources for high-risk equipment.

RBI Process Steps

- Identify equipment and service conditions
- Assess damage mechanisms (corrosion type, rate, location)
- Calculate probability of failure — based on damage mechanisms and current condition
- Calculate consequence of failure — based on fluid, pressure, volume, and location
- Calculate risk = probability × consequence
- Assign inspection plan based on risk level — frequency, method, and extent
- Review and update after each inspection

6.3 Computerised Maintenance Management System (CMMS)

Saudi Aramco uses SAP PM (Plant Maintenance) as its CMMS. The CMMS manages all maintenance work orders, equipment history, spare parts, and preventive maintenance schedules. A Mechanical Supervisor must be competent in:

- Creating and managing work orders in SAP PM
- Reviewing equipment maintenance history to identify repeat failures
- Managing preventive maintenance task lists and schedules
- Tracking spare parts consumption and reorder levels
- Closing work orders with accurate labour, material, and failure code data

6.4 Permit to Work in Maintenance

Every maintenance activity on a live plant requires a Work Permit. The mechanical supervisor is typically the Work Permit Receiver (WPR) — responsible for the crew safety during maintenance. Key maintenance-specific permit requirements:

- LOTO must be applied before any work on rotating or electrical equipment
- Confined space entry permit required for entry into vessels, tanks, exchangers
- Hot work permit required for any welding, grinding, or cutting during maintenance
- Cold work permit required for mechanical isolation, inspection, and disassembly

The mechanical supervisor must verify that all isolation is complete and confirmed — not assumed — before allowing the crew to begin work.

MECHANICAL ENGINEERING ABBREVIATIONS & ACRONYMS

The following table lists all standard abbreviations and acronyms used in mechanical engineering, Saudi Aramco standards, ASME codes, API standards, and industrial documentation. A Mechanical Engineer or Supervisor must recognise and correctly use every abbreviation listed. Exam questions frequently test knowledge of standard codes and their full meanings.

EXAM TIP — Abbreviations Are Tested Directly

Questions often present the full form as one of three answer options. Know every abbreviation in this table. Pay special attention to: MAWP, ASME, API, PWHT, NDT, WPS, PQR, WQT, MTBF, MTTR, RBI, RCM, CBM, NPSHr, NPSHa, BEP, SWL, SWA.

Abbreviation	Full Form	Context / Where Used
SECTION 1 — PRESSURE VESSEL TERMS		
AI	Authorized Inspector	API 510 — must supervise all in-service pressure vessel inspections
ASME	American Society of Mechanical Engineers	Governing body for pressure vessel (Section VIII) and piping (B31.3) codes
CA	Corrosion Allowance	Additional wall thickness added at design stage to account for service life metal loss
CUI	Corrosion Under Insulation	Accelerated corrosion beneath insulation — peak risk -4°C to 175°C
FFS	Fitness for Service	API 579-1 / ASME FFS-1 assessment for in-service equipment not meeting original code
GWUT	Guided Wave Ultrasonic Testing	Long-range pipe screening technique for CUI and wall loss detection
HIC	Hydrogen Induced Cracking	Cracking from atomic hydrogen absorption in wet sour (H2S) service
MAWP	Maximum Allowable Working Pressure	Highest permitted operating pressure at a specified design temperature
MFL	Magnetic Flux Leakage	NDT technique for tank bottom and pipeline inspection
NDE / NDT	Non-Destructive Examination / Testing	Inspection without damaging the component — RT, UT, MT, PT, VT
PEC	Pulsed Eddy Current	Non-intrusive technique for CUI detection through insulation
PRV / PSV	Pressure Relief Valve / Pressure Safety Valve	Spring-loaded device protecting vessels from overpressure
PWHT	Post-Weld Heat Treatment	Controlled heating after welding to reduce residual stresses and improve toughness
RBI	Risk-Based Inspection	API 580/581 — inspection planning based on Probability × Consequence of failure
RD	Rupture Disc	One-time pressure relief device — must be replaced after activation
SCC	Stress Corrosion Cracking	Cracking from combined tensile stress, susceptible material, and corrosive environment

SSCC	Sulfide Stress Corrosion Cracking	SCC mechanism in H2S-containing (sour) environments — governed by NACE MR0175
U-Stamp	ASME U-Stamp	ASME certification mark on pressure vessel nameplate confirming code compliance
SECTION 2 — PIPING TERMS		
AE	Allowable stress at elevated temperature	Material property used in ASME B31.3 wall thickness calculation
API	American Petroleum Institute	Develops standards for oil and gas equipment — API 510, 570, 580, 650, 653
B31.3	ASME B31.3	Process Piping Code — design, material, fabrication, testing for refinery/chemical piping
B31.1	ASME B31.1	Power Piping Code — boiler and power plant piping systems
CML	Condition Monitoring Location	Fixed measurement points on piping circuits for thickness trend monitoring
CS	Carbon Steel	Standard pipe material — ASTM A106 Gr.B for pressure service
DL / Dead Leg	Dead Leg	Stagnant piping section — high corrosion risk from water accumulation
DSS	Duplex Stainless Steel	High strength, corrosion-resistant material for sour and seawater service
E	Joint Efficiency / Quality Factor	ASME B31.3 factor for pipe wall thickness — 1.0 (full RT), 0.85 (spot), 0.70 (none)
FRP	Fibre-Reinforced Plastic	Non-metallic piping material for corrosive service — API 570 applicable
GRP	Glass-Reinforced Plastic	FRP using glass fibre reinforcement — common in seawater and chemical service
GVI	General Visual Inspection	Overall condition assessment — API 570 external inspection method
HF	High Frequency	Designation for high-frequency electrical resistance welded pipe (HF-ERW)
ITP	Inspection and Test Plan	Document defining inspection activities, hold/witness points, and acceptance criteria
LT	Long-Term corrosion rate	API 570 — corrosion rate calculated over the full service history
PE	Plain End	Pipe end preparation — no threading or bevelling
PoF	Probability of Failure	RBI input — how likely the equipment is to fail in a given period
CoF	Consequence of Failure	RBI input — the impact of failure on safety, environment, and production
SCH	Schedule	Pipe wall thickness designator — SCH 40, SCH 80, SCH 160
SS	Stainless Steel	Corrosion-resistant alloy — 304, 316, 316L common grades in process service
ST	Short-Term corrosion rate	API 570 — corrosion rate calculated from the most recent measurements only

UT	Ultrasonic Testing	NDT thickness measurement technique — widely used for CML monitoring
VT	Visual Testing	First and most fundamental NDT method — required before all other NDT
WFMT	Wet Fluorescent Magnetic Particle Testing	Enhanced MT using fluorescent particles and UV light — detects finer surface defects
SECTION 3 — ROTATING EQUIPMENT TERMS		
AHU	Air Handling Unit	HVAC equipment — centrifugal or axial fan driven air distribution
BEP	Best Efficiency Point	Flow rate at which centrifugal pump operates at maximum efficiency
CBM	Condition-Based Maintenance	Maintenance triggered by equipment condition data rather than fixed intervals
DCS	Distributed Control System	Plant control system — monitors and controls equipment including rotating machinery
ESD	Emergency Shutdown	Automatic safety shutdown system for critical equipment and process systems
FFT	Fast Fourier Transform	Signal processing technique converting vibration time-waveform to frequency spectrum
GPA	Gallons Per Minute / Hour	Flow rate unit for pump performance — also expressed as m³/h or l/s
HP	Hydraulic Power / Horsepower	Power unit — pump hydraulic power = ρgQH (density × gravity × flow × head)
MCSA	Motor Current Signature Analysis	Condition monitoring technique detecting motor and driven equipment faults from current signal
MTBF	Mean Time Between Failures	Average operating time between failures — higher is better
MTTR	Mean Time To Repair	Average time to restore failed equipment to service — lower is better
NPSHa	Net Positive Suction Head Available	Actual suction head available at pump inlet — must exceed NPSHr
NPSHr	Net Positive Suction Head Required	Minimum suction head required by pump to prevent cavitation — from manufacturer
OEE	Overall Equipment Effectiveness	Availability × Performance × Quality — world-class benchmark is 85%
PdM	Predictive Maintenance	CBM using monitoring techniques to predict and prevent failures
PM	Preventive Maintenance	Time-based maintenance performed at fixed intervals regardless of condition
RCM	Reliability-Centred Maintenance	Systematic method to determine optimal maintenance strategy for each equipment function
RMS	Root Mean Square	Statistical measure of vibration amplitude — used for overall vibration assessment
RPM	Revolutions Per Minute	Rotational speed of machinery — key operating parameter for all rotating equipment

SIS	Safety Instrumented System	Automated safety system — includes ESD and high-high/low-low trip functions
TBM	Time-Based Maintenance	Fixed interval maintenance — another term for preventive maintenance
VFD	Variable Frequency Drive	Electronic speed control for motors — adjusts pump/fan speed to match demand
λ (lambda)	Failure Rate	Number of failures per unit time — λ = 1/MTBF
SECTION 4 — WELDING AND NDT TERMS		
AE	Acoustic Emission	NDT technique detecting active crack growth and defect activity under load
AWS	American Welding Society	Governs welding codes for structural applications — AWS D1.1 for structural steel
CTOD	Crack Tip Opening Displacement	Fracture mechanics test measuring material toughness
CVN	Charpy V-Notch	Impact toughness test — measures energy absorbed when notched specimen is fractured
DP / PT	Dye Penetrant / Liquid Penetrant Testing	Surface defect detection using coloured or fluorescent dye — all non-porous materials
DT	Destructive Testing	Testing that damages or destroys the test piece — tensile, bend, impact, hardness tests
ERW	Electric Resistance Welded	Pipe manufacturing method — longitudinal seam weld by electrical resistance
FCAW	Flux-Cored Arc Welding	Welding process using tubular wire with flux core — higher deposition than SMAW
GMAW / MIG	Gas Metal Arc Welding / Metal Inert Gas	Wire-fed welding process using inert or active shielding gas
GTAW / TIG	Gas Tungsten Arc Welding / Tungsten Inert Gas	High-quality process for root passes and thin material — non-consumable tungsten electrode
HAZ	Heat Affected Zone	Base metal area adjacent to weld — altered by welding heat, hardness changes occur here
HB / HBW	Hardness Brinell	Hardness measurement unit — NACE MR0175 limit of 200 HBW for sour service CS
HV	Hardness Vickers	Hardness measurement — 1 HV ≈ 1 HB for most industrial steels
IQI / Penetrameter	Image Quality Indicator	Device placed on weld during RT to verify radiograph sensitivity
MT	Magnetic Particle Testing	Surface and near-surface defect detection using magnetic field — ferromagnetic materials only
OD / ID	Outside Diameter / Inside Diameter	Pipe dimension designators
P-No.	P-Number	ASME IX base metal grouping — P1: carbon steel, P4: Cr-Mo, P8: austenitic SS
PAUT	Phased Array Ultrasonic Testing	Advanced UT using electronic beam steering — replacing conventional RT on many Aramco projects
PH	Preheating	Heating base metal before welding to slow cooling rate and prevent cracking

PQR	Procedure Qualification Record	Test record supporting and qualifying a Welding Procedure Specification
PT	Penetrant Testing	Surface NDT method — see DP/PT above
PWHT	Post-Weld Heat Treatment	Controlled heating of completed weld to reduce residual stresses and improve properties
RT	Radiographic Testing	NDT using X-ray or gamma radiation to inspect weld interiors
SAW	Submerged Arc Welding	High-deposition welding process for large diameter pipes and pressure vessels
SMAW / MMAW	Shielded Metal Arc Welding / Manual Metal Arc Welding	Stick welding — most common field welding process on Aramco projects
SR	Stress Relief	Heat treatment to reduce residual stress — used where full PWHT is not required
TOFD	Time of Flight Diffraction	Advanced UT technique — measures defect depth and height using diffracted signals
UT	Ultrasonic Testing	NDT using high-frequency sound to detect internal defects and measure thickness
WPS	Welding Procedure Specification	Written document defining welding variables for a qualified welding procedure
WQT / WPQ	Welder Qualification Test / Welder Performance Qualification	Personal qualification test confirming a welder can produce acceptable welds
SECTION 5 — LIFTING, RIGGING & MECHANICAL STANDARDS		
API 510	API Standard 510	In-service inspection of pressure vessels — qualification, inspection intervals, acceptance criteria
API 570	API Standard 570	In-service inspection of piping systems — inspection classes, corrosion rate calculation
API 580	API Standard 580	Risk-Based Inspection — qualitative RBI methodology
API 581	API Standard 581	Quantitative Risk-Based Inspection — numerical PoF and CoF with specific intervals
API 579	API 579-1 / ASME FFS-1	Fitness for Service — assessment of equipment with defects or degradation
API 650	API Standard 650	Welded steel tanks for oil storage — design and construction
API 653	API Standard 653	In-service inspection, repair, alteration, and reconstruction of above-ground storage tanks
API 682	API Standard 682	Shaft sealing systems (mechanical seals) for pumps — seal type, flush plans, materials
ASME IX	ASME Section IX	Welding and Brazing Qualifications — WPS, PQR, and welder qualification requirements
ASME VIII	ASME Section VIII	Pressure Vessel Design Code — Division 1 (most facilities) and Division 2 (high pressure)
BS	British Standard	UK standards body — BS EN standards now align with European Norms
CE	Carbon Equivalent	Formula assessing weldability of carbon and low-alloy steel — higher CE = more preheat required

EN	European Norm	European standard — EN 13480 for industrial piping, EN 12845 for sprinklers
GI	General Instruction	Saudi Aramco internal governing instruction — GI-2.100 (permits), GI-0007.025 (lifting)
ISO	International Organisation for Standardisation	Global standards — ISO 10816 (vibration), ISO 1940 (balancing), ISO 15156 (sour service)
NACE	National Association of Corrosion Engineers	NACE MR0175 / ISO 15156 — material requirements for sour service equipment
SAEP	Saudi Aramco Engineering Procedure	Aramco procedure document — SAEP-20 governs pressure testing
SAES	Saudi Aramco Engineering Standard	Aramco technical standard — supplements ASME and API for Aramco-specific requirements
SWL	Safe Working Load	Maximum load a rigging component is rated to lift — breaking load / safety factor (5:1)
WLL	Working Load Limit	Same as SWL — term used in EN and ISO rigging standards
MBL	Minimum Breaking Load	The minimum load at which the rigging component will fail — SWL = MBL / safety factor
PPE	Personal Protective Equipment	Hard hat, safety glasses, safety boots, gloves — mandatory on all Aramco sites
SWA	Stop Work Authority	Right of any worker to stop unsafe work — Aramco policy and Saudi Labour Law right
JSA	Job Safety Analysis	Hazard identification and risk assessment tool completed before hazardous work begins
PTW	Permit to Work	Formal system authorising work on Aramco facilities — GI-2.100 governs 7 permit types
CMMS	Computerised Maintenance Management System	Software for managing work orders, PM schedules, and equipment history — typically SAP PM on Aramco
ERP	Enterprise Resource Planning	Integrated business system — SAP is the standard ERP on most large Aramco projects
KPI	Key Performance Indicator	Metric for measuring performance — MTBF, MTTR, OEE, TRIR are common engineering KPIs
TRIR	Total Recordable Incident Rate	Safety KPI — recordable incidents per 200,000 man-hours worked
LTI	Lost Time Injury	Work injury causing one or more lost working days

PART 7 — EXAM QUESTION BANK (200 QUESTIONS)

Total Questions	200
Answer Options	3 per question (A, B, C)
Topic Areas	Pressure Vessels, Piping, Rotating Equipment, Welding & NDT, Lifting & Rigging, Maintenance, Design Codes
Answer Key	Last page only — do not look until finished
Passing Score	Aim for 180+ (90%) before sitting the real Aramco exam
Reference	ASME VIII, ASME B31.3, ASME IX, API 510, API 570, API 580, API 686, NACE MR0175, ISO 10816

Answer all 200 questions before checking the answer key. Write your answer (A, B, or C) next to each question number. Time yourself — allow approximately 1.5 minutes per question.

Q	Question	Options
1	Which ASME VIII Division applies to most industrial pressure vessels on Aramco projects?	A Division 1 — design by formula, most common for process vessels up to 3,000 psi B Division 2 — design by analysis, for critical high-pressure service C Division 3 — for ultra-high pressure vessels above 10,000 psi
2	The minimum wall thickness formula for a cylindrical pressure vessel shell (ASME VIII Div 1) is t = PR / (SE - 0.6P). What does E represent?	A Elastic modulus of the shell material B Joint efficiency factor — 1.0 for full radiography C External pressure factor
3	If design pressure doubles in a pressure vessel, what happens to the required minimum wall thickness (all other variables constant)?	A It halves B It doubles C It increases by 50%
4	Which head geometry requires the thinnest wall thickness for a given pressure and diameter?	A Flat head B Ellipsoidal (2:1) head C Hemispherical head
5	API 510 requires internal inspection of a pressure vessel at a maximum interval of:	A 5 years B 10 years (or half the remaining life — whichever is less) C 15 years
6	A pressure vessel measured 12.5mm wall thickness 5 years ago. Current measurement is 11.5mm. What is the corrosion rate in mm/year?	A 0.1 mm/year B 0.2 mm/year C 1.0 mm/year

7	The remaining life of a vessel is 10 years. When should the next internal inspection be scheduled per API 510?	A In 10 years B In 5 years (remaining life / 2) C In 2 years
8	What does the U stamp on a pressure vessel nameplate confirm?	A The vessel passed ultrasonic inspection B The vessel was manufactured in compliance with ASME VIII C The vessel is approved for use on Aramco projects
9	API 579 is used when a vessel has in-service damage (corrosion, crack, dent). What does it determine?	A The repair method to use B Whether the vessel is fit for continued service at current or reduced conditions C The inspection interval for the vessel
10	What is the hydrostatic test pressure for a pressure vessel under ASME VIII Div 1?	A 1.1 times MAWP B 1.3 times MAWP × (cold allowable stress / hot allowable stress) C 1.5 times MAWP
11	Which ASME B31 code governs process piping on Saudi Aramco refinery and petrochemical projects?	A ASME B31.1 B ASME B31.3 C ASME B31.4
12	A raised face (RF) flange should never be mated directly with a flat face (FF) flange because:	A The bolt pattern is different B The raised face loads the outer part of a full-face gasket, causing flange rotation and gasket blowout C RF flanges are a higher pressure class than FF flanges
13	API 570 classifies process piping circuits into Class 1, 2, and 3. Which service is Class 1?	A Non-flammable, non-toxic, low pressure utility service B H2S service, HF acid, lethal service, high-pressure steam C General hydrocarbon service
14	What is the hydrostatic test pressure for piping under ASME B31.3?	A 1.1 × design pressure B 1.3 × design pressure C 1.5 × design pressure × (cold / hot allowable stress)
15	Which valve type is preferred for throttling service (flow control) in process piping?	A Gate valve B Globe valve C Ball valve
16	The Best Efficiency Point (BEP) of a centrifugal pump is:	A The point of maximum flow on the pump curve B The operating point where hydraulic efficiency is at its maximum C The point of maximum head on the pump curve
17	Cavitation in a centrifugal pump occurs when:	A Flow rate exceeds the design maximum

		B NPSHa drops below NPSHr — local pressure falls below fluid vapour pressure C Discharge pressure exceeds the pump shut-off head
18	What is the characteristic sound of cavitation in a centrifugal pump?	A Smooth humming at high frequency B Crackling or sound like gravel passing through the pump C High-pitched squealing from the shaft seal
19	A pump should operate within what percentage range of its Best Efficiency Point flow to maintain reliability?	A 50% to 150% of BEP B 70% to 120% of BEP C 90% to 110% of BEP only
20	Shaft misalignment at what type produces cyclic bending of the coupling at 2× running speed frequency?	A Unbalance B Angular misalignment C Parallel (offset) misalignment
21	Vibration at 1× running speed in a centrifugal pump most commonly indicates:	A Bearing defect B Rotor unbalance C Cavitation
22	Surge in a centrifugal compressor occurs when:	A Flow exceeds the maximum stable flow for the compressor B Flow drops below the minimum stable flow — discharge pressure cannot be maintained and flow reverses C Discharge temperature exceeds the design maximum
23	API RP 686 governs which aspect of rotating equipment work on Aramco projects?	A Design of centrifugal pumps B Machinery installation and installation design — including alignment requirements C Compressor surge control
24	Which rotating equipment type is most sensitive to changes in gas molecular weight?	A Reciprocating compressors B Screw compressors C Centrifugal (dynamic) compressors
25	The minimum sling angle from horizontal on Saudi Aramco lifting operations is:	A 30 degrees B 45 degrees C 60 degrees
26	At a sling angle of 30 degrees from vertical, each sling leg carries what load factor compared to vertical (90 degrees)?	A 1.15 times the load B 1.41 times the load C 2.0 times the load
27	A critical lift is defined on Aramco projects as a lift exceeding what percentage of the crane rated capacity?	A 50% B 75% C 90%
28	What is the rejection criterion for a wire rope sling under ASME B30.9?	A Any visible wear on the outer wires

		B 10 randomly distributed broken wires in one rope lay or 5 broken wires in one strand C Any evidence of surface corrosion
29	The Working Load Limit (WLL) of rigging hardware is based on:	A The weight of the heaviest load ever lifted B The Minimum Breaking Force divided by the applicable safety factor C The rated capacity of the crane being used
30	Which lifting document is required for every lift on an Aramco project?	A Lifting permit only B Formal lifting plan reviewed and approved before the lift C Work permit only
31	SMAW welding process is also known as:	A MIG welding B Stick welding — Shielded Metal Arc Welding C TIG welding
32	Which welding process is preferred for root passes in stainless steel and alloy piping due to highest weld quality?	A SMAW B FCAW C GTAW (TIG)
33	What is a Welding Procedure Specification (WPS)?	A The welder qualification test record B The written instruction defining how a weld must be made — process, filler, preheat, position, current C The non-destructive test result for a completed weld
34	A PQR (Procedure Qualification Record) documents:	A The welding variables used during procedure qualification and the test results that validate the WPS B The welder performance test results C The NDT results for production welds
35	A change in which ASME IX variable requires a new PQR to be conducted?	A Non-essential variable B Supplementary essential variable (when no impact testing required) C Essential variable
36	Magnetic Particle Testing (MT) can only be used on:	A All metals including aluminum and stainless steel B Ferromagnetic materials only — carbon steel and low alloy steel C Non-metallic materials
37	Liquid Penetrant Testing (PT) detects:	A Subsurface volumetric defects B Surface-breaking defects on non-porous materials only C Defects at any depth in the material

38	Radiographic Testing (RT) is least effective at detecting:	A Porosity and slag inclusions B Laminar defects (cracks) parallel to the X-ray beam C Lack of fusion defects
39	Ultrasonic Testing (UT) is the preferred method for:	A Detecting surface cracks on painted surfaces B Volumetric flaw detection and accurate wall thickness measurement C Verifying weld surface profile
40	The minimum acceptable film density for radiographic examination per ASME V Article 2 is:	A 1.0 B 2.0 C 3.0
41	Predictive Maintenance (PdM) differs from Preventive Maintenance (PM) because:	A PdM is based on equipment condition rather than fixed time intervals B PdM requires no instrumentation C PdM is only applied to electrical equipment
42	Risk-Based Inspection (RBI) is governed by:	A API 510 and API 570 B API 580 and API 581 C ASME VIII and ASME B31.3
43	In RBI, risk is calculated as:	A Probability of failure + Consequence of failure B Probability of failure × Consequence of failure C Consequence of failure / Probability of failure
44	Saudi Aramco uses which CMMS system for maintenance management?	A IBM Maximo B SAP Plant Maintenance (SAP PM) C Oracle EAM
45	Which maintenance strategy is most appropriate for safety-critical rotating equipment with gradual failure modes?	A Run-to-Failure B Fixed interval Preventive Maintenance only C Predictive Maintenance with continuous condition monitoring
46	Before any maintenance work on rotating equipment, what must be completed first?	A Obtain the work order from CMMS B LOTO — Lockout/Tagout — confirming zero energy state before work begins C Notify the process operator
47	ASME flange classes are defined in which standard?	A ASME B31.3 B ASME B16.5 C API 570
48	The highest ASME B16.5 flange class is:	A 1500 B 2500

		C 3000
49	Submerged Arc Welding (SAW) is most suitable for:	A Site welding of small-bore pipe in all positions B Long seam welding of thick wall vessels in the flat position C Root passes in alloy piping
50	What does NPSHr (Required NPSH) represent?	A The maximum suction energy available from the piping system B The minimum suction energy required at the pump inlet to prevent cavitation — determined by pump design C The normal operating suction pressure

Q	Question	Options
51	Long radius (LR) elbows are preferred over short radius (SR) elbows in process piping because:	A LR elbows are cheaper to fabricate B LR elbows have lower pressure drop and lower erosion at the bend C LR elbows are lighter
52	An eccentric reducer in a pump suction line should be installed with the flat side:	A Down — to avoid gas accumulation at high point B Up — to prevent gas pocket formation at the top of the reducer C Either side — orientation does not matter for pump suction
53	What is the purpose of a pulsation dampener on a reciprocating compressor?	A To increase compressor efficiency B To reduce pressure pulsations that would damage piping and instrumentation C To cool the compressed gas
54	ISO 10816 governs:	A Pump performance testing B Mechanical vibration evaluation criteria for rotating machinery C Compressor surge limits
55	Which NDT method requires the material surface to be cleaned before application and allows a specified dwell time?	A Magnetic Particle Testing (MT) B Ultrasonic Testing (UT) C Liquid Penetrant Testing (PT)
56	Positive Material Identification (PMI) is performed to:	A Measure wall thickness of piping B Verify the chemical composition of material matches the specified alloy C Test for weld hardness
57	The purpose of Positive Material Identification (PMI) is critical when:	A Installing carbon steel piping in utility service

		B Installing alloy or stainless steel piping — wrong material in corrosive or high-temperature service causes premature failure C Performing routine maintenance on low-pressure piping
58	Pre-heat before welding is required primarily to:	A Speed up the welding process B Prevent hydrogen-induced cracking (cold cracking) — particularly in high-carbon and alloy steels C Improve weld bead appearance
59	Post Weld Heat Treatment (PWHT) is performed primarily to:	A Improve weld surface appearance B Relieve residual stresses in the weld and heat-affected zone; restore mechanical properties; reduce hardness C Increase weld strength above base metal
60	The heat-affected zone (HAZ) in a weld is:	A The area of the weld where the filler metal is deposited B The base metal area adjacent to the weld that was not melted but had its microstructure altered by heat C The visible surface of the completed weld
61	Hydrostatic testing is preferred over pneumatic testing for pressure systems because:	A Hydrostatic testing is faster B Water stores far less energy than gas — failure during hydrostatic test is less dangerous C Hydrostatic testing requires lower test pressure
62	What is the purpose of a spiral wound gasket in flange connections?	A To prevent bolt corrosion B To provide a resilient, reliable seal in high-temperature and high-pressure flange connections C To increase flange load capacity
63	A Ring Type Joint (RTJ) flange is used in which service condition?	A Low pressure, ambient temperature utilities B High pressure and high temperature service requiring a metal-to-metal seal C Vacuum service
64	What is the primary cause of pump seal failure in centrifugal pumps?	A Oversized impeller B Shaft misalignment and operation far outside BEP — both cause shaft deflection and mechanical seal face damage C Insufficient discharge pressure
65	A centrifugal pump is operating with low flow and high head. What is the likely consequence?	A Cavitation from NPSHa exceeding NPSHr B Recirculation — internal recirculation at impeller inlet and outlet causes vibration, noise, and erosion C Overloading of the motor

66	What does API 686 specify regarding cold alignment of rotating equipment?	A Equipment must be aligned cold and no allowance made for thermal growth B Equipment must be aligned to target values that account for thermal growth — so the equipment is in alignment at operating temperature C Alignment tolerance is +/- 0.5mm in all conditions
67	Which type of bearing is self-aligning and can accommodate shaft deflection?	A Deep groove ball bearing B Cylindrical roller bearing C Spherical roller bearing
68	An induction motor driving a centrifugal pump trips on high current. What is the most likely cause if the pump was running normally before the trip?	A Low suction pressure B Dense phase operation — pump operating at very low head with high flow, overloading the motor C Seal failure
69	The purpose of an anti-surge control valve on a centrifugal compressor is to:	A Regulate the compressor suction pressure B Recycle gas from discharge back to suction to maintain minimum stable flow and prevent surge C Control the discharge temperature
70	Which maintenance technique uses infrared thermography as a condition monitoring tool?	A Run-to-failure maintenance B Predictive maintenance (PdM) C Corrective maintenance
71	The Reliability-Centred Maintenance (RCM) process identifies maintenance tasks based on:	A Equipment age only B Analysis of failure modes, effects, and consequences for each critical asset C Manufacturer recommendations only
72	What is a P-F interval in maintenance terminology?	A The period between preventive maintenance tasks B The time between a potential failure becoming detectable and the point of functional failure C The planned frequency of inspection
73	Oil analysis as a predictive maintenance tool identifies:	A Shaft alignment condition B Wear particles, contamination, and lubricant degradation indicating developing bearing or gear failure C Rotor unbalance
74	What is the consequence of operating a pump with the discharge valve closed (deadheading)?	A No consequence if the motor trips on overcurrent B Energy input heats the trapped fluid — can cause violent vaporisation and pump damage; seal failure; impeller damage C The pump will simply stop flowing

75	A mechanical supervisor is the Work Permit Receiver (WPR) for a vessel entry. What is their primary duty during the work?	A To perform gas testing inside the vessel B To remain responsible for crew safety — ensure permit conditions are maintained; stop work if conditions change C To sign off the maintenance completion report
76	Corrosion Under Insulation (CUI) is a major risk on which type of equipment?	A Bare uninsulated carbon steel pipe above 200°C B Insulated carbon steel piping and vessels operating between -4°C and 175°C — particularly in humid environments C Stainless steel equipment in all conditions
77	The primary inspection method for detecting Corrosion Under Insulation (CUI) without removing insulation is:	A Visual inspection B Profile radiography or pulsed eddy current testing (PEC) C Liquid penetrant testing
78	Stress Corrosion Cracking (SCC) requires which three conditions simultaneously?	A High temperature, high pressure, and corrosive fluid B Susceptible material, tensile stress, and corrosive environment — remove any one and SCC stops C Low pH, high velocity, and elevated temperature
79	Hydrogen Induced Cracking (HIC) is most commonly found in:	A Austenitic stainless steel in chloride environments B Carbon steel in wet H2S service — hydrogen atoms diffuse into steel and form blisters at inclusion sites C Aluminum alloys in high temperature service
80	What is the minimum required overlap for a reinforcement pad on a nozzle opening in a pressure vessel shell?	A Equal to the diameter of the nozzle B Calculated to replace the area removed by the opening — per ASME VIII area replacement rules C 50mm on each side of the nozzle
81	Hardness testing of a weld is performed to verify:	A Tensile strength of the weld metal B That PWHT was effective — excessive hardness indicates susceptibility to hydrogen cracking C Weld bead geometry
82	The Vickers hardness limit for welds in wet H2S service per NACE MR0175 / ISO 15156 is:	A 200 HV maximum B 248 HV (HRC 22) maximum C 300 HV maximum
83	A pressure safety valve (PSV) is set at the MAWP of the vessel. It must be tested at what interval per API 576?	A Every 1 year B Every 5 years (or more frequently based on service history)

		C Every 10 years
84	What does MAWP stand for?	A Maximum Allowable Working Pressure B Minimum Allowable Working Pressure C Maximum Actual Working Pressure
85	A vessel operating above its MAWP is protected by:	A The thickness of the vessel wall only B Pressure safety valves (PSVs) and/or rupture discs set at or below MAWP C The operator monitoring pressure gauges
86	The purpose of a rupture disc upstream of a PSV is:	A To increase the PSV set pressure B To protect the PSV from corrosive or plugging service fluids; provides a positive seal against leakage C To replace the PSV in low-pressure service
87	What type of corrosion produces a uniform reduction in wall thickness across the surface?	A Pitting corrosion B Galvanic corrosion C General (uniform) corrosion
88	Galvanic corrosion occurs when:	A Acidic fluid contacts carbon steel B Two dissimilar metals are in electrical contact in the presence of an electrolyte — the more active metal corrodes preferentially C High-velocity fluid causes erosion of the pipe wall
89	Erosion-corrosion is most severe at:	A Straight pipe sections with uniform flow B Elbows, tees, reducers, and other locations where flow changes direction or velocity — particularly in wet gas or slurry service C Flanged connections at low velocity
90	API 653 governs:	A Pressure vessel inspection B Above-ground storage tank inspection, repair, alteration, and reconstruction C Piping inspection
91	The minimum shell thickness for an above-ground storage tank shell is calculated based on:	A Wind load only B Hydrostatic head of stored product and corrosion allowance — API 650 / API 653 formula C Seismic load only
92	What is the purpose of a cathodic protection system on a storage tank bottom?	A To prevent lightning strike damage B To prevent electrochemical corrosion of the tank bottom from soil-side and product-side contact C To ground the tank during product transfer
93	Acoustic Emission Testing (AET) is used on storage tanks to:	A Measure shell thickness

		B Detect active corrosion and cracking in the tank bottom and shell without emptying the tank C Test the tank nozzle welds
94	A tee in a piping system should be replaced with an elbow when the branch flow is:	A Always — tees cause more pressure drop than elbows B In the run direction — tees are used for branch connections, not flow direction changes C Never — tees and elbows serve different functions and cannot be interchanged
95	The purpose of a spectacle blind (spade blind) in a piping system is:	A To permanently isolate a branch line B To provide positive isolation (blind) or positive flow path (spacer/ring) — visual confirmation of isolation state from the handle position C To reduce flow velocity
96	Which pump type is most appropriate for high viscosity fluids (heavy oil, polymers)?	A Centrifugal pump — high flow, low head B Positive displacement pump (gear, screw, or reciprocating) — maintains flow regardless of viscosity C Axial flow pump
97	What is the purpose of a mechanical seal in a centrifugal pump?	A To balance the hydraulic axial thrust on the impeller B To prevent leakage of process fluid along the shaft from the pump casing to atmosphere C To reduce pump vibration
98	Double mechanical seals with a barrier fluid system (API Plan 53) are used when:	A The pumped fluid is clean water B The pumped fluid is toxic, flammable, or corrosive — zero leakage to atmosphere is required C The pump operates at very low speed
99	The term "pigging" in pipeline operations refers to:	A Hydrostatic testing of the pipeline B Passing a device through the pipeline for cleaning, inspection, or product separation C Pressure relief of the pipeline
100	Which standard governs the inspection and testing of cranes on Saudi Aramco projects?	A ASME B30.2 B ASME B30.5 (mobile cranes) and ASME B30.2 (overhead cranes) C API 686

Q	Question	Options
101	Before a crane is used on an Aramco project, it must have a current:	A Insurance certificate only B Third party load test certificate and annual inspection from an approved inspection body C Manufacturer service record
102	A tandem lift (two cranes lifting one load) is classified as:	A A routine lift B A critical lift requiring engineer-approved lifting plan and dedicated supervision C Only permitted with Aramco Lifting Authority approval
103	The term "derating" a crane means:	A Reducing the boom length to increase capacity B Reducing the rated capacity when operating conditions (boom angle, outrigger extension, boom length) reduce the safe capacity below the chart rating C Increasing the lift speed
104	What must be done before lifting near overhead power lines?	A Notify the crane operator only B Establish minimum safe approach distances; obtain electrical authority approval; appoint a dedicated spotter; de-energise lines where practical C Proceed if the boom does not touch the lines
105	The purpose of a tag line on a crane lift is:	A To support part of the load weight B To control load swing and orientation during the lift — never to support the load C To connect the load to the crane hook
106	A load radius increases (boom moves outward) during a crane lift. What happens to the crane rated capacity?	A It increases — longer boom reach lifts more B It decreases — rated capacity reduces as radius increases (crane is more prone to tipping) C It stays the same — capacity depends only on load weight
107	Softeners or padding should be used when rigging wire rope slings around:	A Round loads with smooth surfaces B Loads with sharp edges or corners — sharp edges cut sling wire and reduce WLL C All loads regardless of shape
108	Which P-number group in ASME IX covers carbon steel (most common piping and vessel material)?	A P-No. 1 B P-No. 5 C P-No. 8
109	P-No. 8 in ASME IX covers:	A Carbon steel B Chromium-molybdenum alloy steel C Austenitic stainless steel

110	A welding inspector discovers a surface crack in a completed weld. Which NDT method should be used first to characterise the crack?	A Radiographic Testing (RT) B Visual Testing (VT) and then Magnetic Particle Testing (MT) or Liquid Penetrant Testing (PT) C Ultrasonic Testing (UT) only
111	Phased Array Ultrasonic Testing (PAUT) is increasingly used on Aramco projects because:	A It is cheaper than conventional UT B It provides volumetric examination with faster coverage, better flaw characterisation, and a permanent electronic record — replacing RT in many applications C It requires no operator qualification
112	What is the purpose of a witness point (W) in an Inspection and Test Plan (ITP)?	A Work stops until the witness party arrives and approves before proceeding B The witness party must be notified — if they do not attend after proper notice, work may proceed without them C Only the contractor performs the inspection — client need not be present
113	What is the purpose of a hold point (H) in an ITP?	A Work may proceed if the hold party is busy elsewhere B Work shall not proceed beyond this point without prior written approval from the designated hold party C The hold party reviews the records after the work is complete
114	Corrosion allowance in pressure vessel design is:	A A safety factor applied to the design pressure B Additional wall thickness added beyond the calculated minimum to allow for metal loss during the design life C The maximum allowable reduction in wall thickness before repair is required
115	A vessel has a calculated minimum required thickness of 8mm. With a 3mm corrosion allowance, what is the nominal design thickness?	A 8mm B 11mm C 5mm
116	Weld joint efficiency (E) in ASME VIII Div 1 is 1.0 when:	A The weld is visually inspected only B Full radiographic examination (100% RT) is performed on all pressure welds C Spot radiography (10% RT) is performed
117	What is the consequence of using a lower joint efficiency value (E = 0.7) in pressure vessel design?	A Wall thickness decreases — the vessel becomes lighter B Wall thickness increases — the vessel requires more material to compensate for reduced confidence in weld quality C The MAWP decreases proportionally

118	The term "minimum design metal temperature" (MDMT) is critical for pressure vessels because:	A It defines the maximum operating temperature B It defines the lowest temperature at which the vessel material has sufficient toughness (Charpy impact energy) to resist brittle fracture C It sets the minimum preheat temperature for welding
119	Brittle fracture in pressure vessels is most likely to occur when:	A Operating at high temperature and high pressure simultaneously B Operating at or below the MDMT — particularly during start-up, shutdown, or emergency depressurisation with cold fluid C The vessel is overpressured above MAWP
120	The Charpy impact test is used to measure:	A Tensile strength of the weld metal B Toughness of the material at low temperature — its ability to absorb energy without brittle fracture C Hardness of the heat-affected zone
121	What type of corrosion occurs in austenitic stainless steel exposed to chloride environments at elevated temperature?	A General uniform corrosion B Chloride Stress Corrosion Cracking (Cl-SCC) C Pitting corrosion only
122	Sensitisation in austenitic stainless steel (e.g., 316SS) occurs when:	A The material is cold-worked during fabrication B The steel is heated to 450-850°C — chromium carbides precipitate at grain boundaries, depleting chromium and causing intergranular corrosion C The steel is exposed to high-velocity fluid
123	Weld Overlay (cladding) is used in pressure vessels to:	A Increase the mechanical strength of the vessel shell B Apply a corrosion-resistant alloy layer to a less expensive carbon steel shell — combining structural strength with corrosion resistance C Repair weld defects in the base metal
124	An ASME B16.5 Class 300 flange has a higher pressure rating than Class 150 at the same temperature because:	A Class 300 flanges are made from a different material B Higher flange class indicates heavier flange dimensions — greater bolt load and gasket seating capacity C Class 300 uses a different gasket type
125	The correct sequence for bolt tightening on a flanged connection is:	A Tighten bolts sequentially around the flange (clockwise)

		B Tighten bolts in a cross (star) pattern — opposite bolts first — to achieve uniform gasket loading C Tighten the bottom bolts first to seat the flange
126	What does the term "deadweight" mean in the context of piping stress analysis?	A The weight of product only B The sustained load from the weight of pipe, fluid, insulation, and attached equipment — acts continuously on the piping system C The load during hydrostatic testing
127	Thermal expansion stress in piping is classified as:	A Sustained stress — acts continuously B Displacement (self-limiting) stress — created by thermal growth; relieved as the pipe deforms C Occasional stress — acts intermittently
128	A pipe anchor fixes:	A Pipe from lateral movement only B All six degrees of freedom — prevents translation and rotation in all directions C Vertical movement only
129	A pipe guide allows movement in which direction?	A All directions B Along the pipe axis only — prevents lateral movement while allowing axial thermal growth C Vertical direction only
130	Slug flow in a piping system occurs when:	A Pipe is operating in fully turbulent flow B Large liquid slugs alternate with gas pockets in two-phase flow — causes severe dynamic forces and vibration at elbows C Flow velocity is below the minimum for continuous flow
131	What is the purpose of a suction strainer on a centrifugal pump?	A To increase suction pressure B To protect the pump impeller and seal from debris — must be cleaned regularly; a blocked strainer reduces NPSHa and causes cavitation C To reduce suction velocity
132	A high differential pressure across a pump suction strainer during operation indicates:	A The pump is operating efficiently B The strainer is partially or fully blocked — immediate maintenance required before cavitation damage occurs C The suction valve is partially closed
133	Which bearing arrangement is correct for the fixed (located) bearing on a centrifugal pump shaft?	A A bearing that allows axial movement in both directions B A bearing that locates the shaft axially — preventing thermal and load-induced shaft migration

		C Any bearing type can be used at the fixed position
134	The purpose of cooling water in a mechanical seal flush plan (API Plan 23) is:	A To cool the motor bearing B To reduce the seal face temperature — particularly in hot fluid service where fluid vaporisation at seal faces must be prevented C To lubricate the shaft
135	An Aramco Mechanical Supervisor observes a worker attempting to remove a flange bolt without first confirming that the line has been depressurised and drained. The correct action is:	A Allow the work to continue if the pressure gauge reads zero B Stop work immediately — LOTO must confirm zero pressure and zero energy state; gauge may be faulty or line may contain trapped pressure C Advise the worker to be careful
136	What is the purpose of a drip leg (condensate pot) in a steam piping system?	A To measure steam flow B To collect and drain condensate — preventing water hammer and slug flow in the steam line C To reduce steam pressure
137	Water hammer in piping is caused by:	A Excessive pipe support spacing B Rapid valve closure or pump trip — sudden deceleration of flowing fluid creates a pressure wave that can rupture pipe or damage equipment C Operating at low flow velocity
138	The term "line list" in a piping project refers to:	A A drawing showing pipe routing B A document listing all piping lines with service, design pressure, design temperature, material, insulation, and testing requirements C A schedule of valve types and quantities
139	Material Test Reports (MTRs) are required for pressure-containing components to:	A Confirm the delivery date of the material B Certify the chemical composition and mechanical properties of the material comply with the specified standard (e.g., ASTM A106) C Confirm the pipe schedule
140	Traceability in piping material control means:	A Tracking the delivery location of materials on site B Being able to link every installed component back to its mill certificate — confirming material identity at every stage from receipt to installation C Monitoring material costs against budget
141	What standard governs the design of above-ground storage tanks on Aramco projects?	A API 510 B API 650 C API 653

142	A floating roof on a storage tank is designed to:	A Prevent rain from entering the tank B Rest on and move with the liquid surface — minimising the vapour space and reducing evaporation losses and fire risk C Increase the tank storage capacity
143	The annular plate of a storage tank is:	A The roof structure B The bottom plate at the perimeter of the tank — thicker than the centre plates; welded to the shell C The floating roof guide system
144	Tank settlement inspection under API 653 requires measuring:	A Shell corrosion only B Differential settlement around the tank perimeter and absolute settlement at shell and centre — excessive settlement causes shell distortion and bottom plate cracking C Product level only
145	Which inspection method is used to assess tank bottom corrosion without cleaning and entering the tank?	A Hydrostatic testing B Magnetic Flux Leakage (MFL) scanning — detects bottom plate pitting and corrosion from inside the tank C Ultrasonic testing from outside
146	An Aramco Mechanical Engineer discovers that a replacement pipe installed during maintenance is the wrong material grade (carbon steel instead of stainless steel). What is the correct action?	A Accept it if the pressure rating is adequate B Stop work; issue a Non-Conformance Report (NCR); remove and replace with correct material; investigate why the wrong material was installed C Apply a corrosion inhibitor coating and continue
147	A Non-Conformance Report (NCR) is raised when:	A A work activity is completed ahead of schedule B Any material, workmanship, or inspection result does not meet the specified requirements — regardless of magnitude C A subcontractor changes a work method
148	The purpose of a Punch List at project completion is to:	A Record all materials consumed on the project B Document all outstanding items — defects, missing components, incomplete work — that must be resolved before mechanical completion or handover is accepted C List all approved change orders
149	Mechanical Completion (MC) on a Saudi Aramco project means:	A The project is complete and ready for operation B All mechanical installation is complete per drawings and specifications — all punch list A-items are cleared — but the system has not yet been commissioned

		C The final inspection has been passed
150	The Pre-Commissioning stage on a rotating equipment package includes:	A First start-up and performance testing B Cleaning (flushing, blowing), pressure testing, alignment verification, lube oil system filling, instrument loop checks — before first start C Handing over the equipment to operations

Q	Question	Options
151	Flushing of a new piping system before commissioning is performed to:	A Pressure test the system B Remove construction debris, weld spatter, mill scale, and contamination that would damage rotating equipment seals, valves, and instruments C Check the pipe alignment
152	A minimum flow bypass line on a centrifugal pump is installed to:	A Increase pump discharge pressure B Maintain minimum stable flow through the pump when process demand is low — preventing heat buildup, cavitation, and internal recirculation damage C Reduce pump speed
153	The pump performance curve shows the relationship between:	A Flow rate and motor current only B Flow rate (Q) and total head (H), with additional curves for efficiency, NPSH required, and power C Speed and vibration level
154	To increase the flow of a centrifugal pump without changing the pump, the correct action is:	A Increase the discharge pressure B Impeller trimming (reducing impeller diameter) — this reduces head and shifts the operating point to higher flow on the system curve C Increase suction pressure only
155	Impeller trimming in a centrifugal pump is performed to:	A Increase pump head and reduce flow B Reduce pump head and power consumption — match pump curve to system requirements without changing pump casing C Increase NPSH required
156	The affinity laws for centrifugal pumps state that when speed doubles:	A Flow doubles, head doubles, power doubles B Flow doubles, head quadruples, power increases by factor of 8 C Flow doubles, head doubles, power quadruples
157	Variable speed drives (VSDs) on centrifugal pumps save energy because:	A They increase the pump efficiency B Reducing speed reduces flow with a cube reduction in power — much more efficient than throttling the discharge valve at full speed C They increase the system pressure
158	What is the purpose of a pressure relief device (PRD) on a pump casing?	A To control pump suction pressure

		B To protect the pump casing from overpressure — typically from blocked discharge valve with pump running; limits pressure to rated casing pressure C To regulate flow through the pump
159	Gland packing in an older pump is being replaced with a mechanical seal. What is the primary benefit?	A Lower first cost B Zero or near-zero leakage to atmosphere versus the intentional controlled leakage required for gland packing cooling and lubrication C Higher flow capacity
160	A centrifugal compressor operating in surge can be identified by:	A Gradually increasing discharge pressure B Violent flow reversal with cyclic noise, severe vibration, and fluctuating discharge pressure — the compressor surges repeatedly until anti-surge control intervenes C Smooth operation with slightly reduced flow
161	The critical speed of a rotating shaft is the speed at which:	A The shaft reaches its maximum safe operating speed B The rotational frequency coincides with the natural frequency of the shaft — causing resonance and potentially catastrophic vibration C The bearing temperature reaches its maximum
162	Rotating equipment must not be operated at or near its critical speed because:	A Power consumption increases significantly B Resonance amplifies vibration amplitude to potentially destructive levels — shaft, bearing, and seal damage C Seal temperature exceeds the design limit
163	The term "rotor balancing" refers to:	A Equalising axial load on thrust bearings B Correcting the mass distribution of a rotating element so that centrifugal forces are balanced and vibration at 1× running speed is minimised C Setting the correct alignment between motor and pump
164	ISO 1940 defines balancing quality grades for rotating machinery. Which grade G applies to centrifugal pumps?	A G 0.4 (precision grinding wheels) B G 6.3 (centrifugal pumps and fans) C G 40 (agricultural machinery)
165	An Aramco Mechanical Engineer receives an inspection report showing a vessel wall thickness has fallen below the calculated minimum required thickness. What is the required action?	A Continue to operate — the corrosion allowance will compensate B The vessel must be immediately de-rated, repaired, or taken out of service — operating below minimum thickness is a code violation and safety risk C Increase inspection frequency and monitor
166	The term "fitness for service" assessment allows a vessel with damage to:	A Operate indefinitely without repair if the damage is not worsening B Continue operating at current or reduced conditions if the assessment demonstrates

		adequate structural integrity for a defined period — with a new inspection plan C Bypass normal inspection requirements
167	When a pressure vessel undergoes a repair (welding), which code governs the repair?	A API 510 for scope; original code of construction (ASME VIII) for repair requirements B Only ASME VIII regardless of original code C Local building code only
168	A "hot tap" connection is a method of:	A Connecting a new branch to a piping system that has been depressurised and drained B Connecting a new branch to a live piping system without shutting down — requires engineering assessment and specialised equipment C Welding in high-temperature service
169	Online leak sealing (clamp injection) on a live piping system is:	A A permanent repair equivalent to welding B A temporary measure — it must be followed by a permanent repair at the next available shutdown C Not permitted on Aramco projects under any circumstances
170	What is the purpose of a hydraulic torque wrench on critical flange bolting?	A To speed up bolt tightening B To apply precise, controlled bolt load — ensuring uniform gasket seating and correct bolt stress within specification C To remove seized bolts
171	The minimum bolt length in a flanged connection must ensure:	A At least 2 full threads are engaged beyond the nut B At least 3 full threads protrude beyond the nut face after final tightening — confirming full thread engagement C The bolt is flush with the nut surface
172	Flange face damage (scratches, grooves, corrosion pitting) that crosses the gasket seating face is a concern because:	A It reduces flange weight B Radial scratches or defects across the seating face create a leak path through the gasket — leakage even at correct bolt load C It only affects the flange appearance
173	The purpose of painting a pressure vessel after fabrication and inspection is:	A Purely for appearance B Corrosion protection of the external surface — surface preparation (blast cleaning) and coating system must comply with project specification C To increase the vessel strength
174	Radiographic examination of a completed weld is performed at what stage?	A Before welding begins — on the base metal B After welding is complete and the weld is cleaned and ground to final profile — before PWHT if required C After PWHT only

175	When performing UT thickness measurement on an insulated pipe, the inspector must:	A Measure through the insulation using a specialist probe B Remove insulation at designated inspection windows or use pulsed eddy current (PEC) to measure through insulation without removal C Wait until the next major shutdown to measure thickness
176	An Aramco Mechanical Supervisor is responsible for ensuring that all maintenance records are:	A Stored in the supervisor's office file B Entered accurately into the CMMS (SAP PM) — failure history, labour, materials, and failure codes — so equipment history is available for future maintenance decisions C Submitted to Aramco at year end
177	Mean Time Between Failures (MTBF) is a maintenance KPI that measures:	A The time to repair equipment after failure B The average operating time between consecutive failures — higher MTBF indicates higher equipment reliability C The number of failures per year
178	Mean Time To Repair (MTTR) measures:	A The average time between failures B The average time required to restore equipment to operational status after a failure — lower MTTR indicates faster maintenance response C The planned maintenance interval
179	Overall Equipment Effectiveness (OEE) is calculated as:	A Availability + Performance + Quality B Availability × Performance × Quality — expressed as a percentage; world-class OEE is typically 85%+ C Uptime / Total time × 100
180	Preventive maintenance task lists in SAP PM define:	A The spare parts stored in the warehouse B The specific maintenance tasks, materials, tools, and time required for each PM — triggered automatically at defined intervals C The contractor rates for maintenance work
181	A Mechanical Engineer on an Aramco project must ensure that all vendor documents for a rotating equipment package include:	A Only the operations manual B Data sheets, performance curves, installation manual, operations and maintenance manual, spare parts list, and all test certificates including factory acceptance test (FAT) results C Only the procurement specification
182	A Factory Acceptance Test (FAT) for a pump package is performed to:	A Test the pump after installation on site B Verify the pump meets its performance specification (head, flow, efficiency, NPSHr) at the manufacturer's facility before shipment C Commission the pump on site
183	The purpose of a Site Acceptance Test (SAT) for a rotating equipment package is:	A To repeat the factory test on site

		B To verify the complete installed system (pump, driver, controls, piping) performs correctly at site conditions after commissioning C To inspect the equipment on arrival at site
184	Grouting of rotating equipment baseplates is critical because:	A It improves the appearance of the installation B Proper grouting ensures a rigid, level, vibration-resistant foundation — poor grouting is a major cause of alignment loss and vibration problems C It prevents corrosion of the baseplate
185	Soft foot in rotating equipment alignment refers to:	A A soft coupling between motor and pump B A condition where one or more machine feet do not sit flat on the baseplate — causes distortion of the machine casing when bolted down, creating misalignment and vibration C Insufficient grout thickness under the baseplate
186	Soft foot must be corrected before performing final shaft alignment because:	A Soft foot affects only the appearance of the installation B Tightening hold-down bolts with soft foot present distorts the machine casing — causing shaft misalignment even when the alignment tools show correct values C Soft foot only affects motor efficiency
187	The purpose of coupling guards on rotating equipment is:	A To protect the coupling from corrosion B To prevent personnel contact with rotating parts — coupling guards are mandatory on all rotating equipment per Aramco HSE requirements; removing them while equipment is running is a stop-work condition C To improve alignment access
188	Laser alignment tools are preferred over dial indicator alignment for:	A All alignment work — laser is always mandatory on Aramco projects B Higher precision, faster setup, real-time digital readings, and electronic records — particularly for high-speed, high-power machines C Simple, low-speed equipment only
189	The term "thermal growth" in rotating equipment alignment means:	A The increase in bearing temperature during operation B The expansion of machine components (pump casing, motor frame, baseplate) as they heat up from ambient to operating temperature — shifts the shaft centrelines and must be accounted for in cold alignment targets C The growth of biological fouling in the pump casing
190	Vibration alarm and trip setpoints for rotating equipment on Aramco projects are typically set based on:	A Any vibration detected by the sensor B ISO 10816 / ISO 20816 guidelines and equipment manufacturer recommendations —

		alarm typically at 6-7 mm/s; trip at 10-12 mm/s (velocity RMS) for general industrial machinery C Operator judgement only
191	What does ASME Section V govern?	A Pressure vessel design B Non-destructive examination methods — the technical requirements for VT, PT, MT, UT, RT, ET, and other NDE methods used for ASME coded work C Welding consumable specification
192	ASME Section II Part A covers:	A Welding procedures B Ferrous material specifications — material standards for carbon steel, alloy steel, and stainless steel used in ASME coded equipment C NDE methods
193	An Aramco Mechanical Engineer is reviewing a WPS for P91 (9Cr-1Mo-V) alloy steel piping. What is the most critical welding requirement to verify?	A Shielding gas composition only B Preheat (minimum 200°C), interpass temperature control, PWHT temperature and duration (760°C ± 14°C for defined hold time) — P91 is highly sensitive to improper heat treatment C Electrode coating type only
194	Duplex stainless steel is used in preference to 316SS in which service condition?	A Cryogenic service below -50°C B Chloride-containing seawater service — duplex offers far better resistance to chloride SCC and pitting than 316SS C High-temperature steam service above 500°C
195	The purpose of solution annealing (solution heat treatment) for austenitic stainless steel is:	A To increase the hardness of the steel B To dissolve chromium carbides back into solid solution — restoring corrosion resistance after sensitisation from welding or hot working C To stress relieve welded joints
196	Aramco SAES-L-350 governs:	A Pressure vessel design B Selection and qualification of pipe joining methods for Saudi Aramco piping systems C Storage tank design
197	The purpose of a Piping and Instrumentation Diagram (P&ID) in mechanical engineering is:	A To show the physical routing of pipes in the plant B To show all process piping, equipment, instrumentation, and control elements — including line sizes, materials, and valve types — as the engineering reference for construction and operation C To calculate pipe stress
198	An isometric drawing (ISO) for piping shows:	A A plan view of the pipe routing from above B A three-dimensional representation of a single piping line — showing all dimensions, fittings, supports, instrument connections, and bill of materials for fabrication and installation

		C The P&ID for one process system
199	Material Requisitions (MRs) for piping on Aramco projects must reference:	A Only the pipe schedule B The applicable Piping Material Class (PMC) — which defines pipe schedule, material grade, fitting and flange standard, valve type, and testing requirements for each service condition C Only the pipe nominal size
200	What score should a Mechanical Engineer or Supervisor candidate achieve on this question bank before sitting the real Aramco approval exam?	A 150+ / 200 B 180+ / 200 (90%) — below this, re-study weak sections before attempting the real exam C 160+ / 200

ANSWER KEY — 200 QUESTIONS

Check your answers only after completing all 200 questions. Any topic below 70% — re-read the relevant Part before reattempting.

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	B	3	B	4	C	5	B
6	B	7	B	8	B	9	B	10	C
11	B	12	B	13	B	14	C	15	B
16	B	17	B	18	C	19	B	20	B
21	B	22	B	23	B	24	C	25	B
26	C	27	B	28	B	29	B	30	B
31	B	32	C	33	B	34	A	35	C
36	B	37	B	38	B	39	B	40	B
41	A	42	B	43	B	44	B	45	C
46	B	47	B	48	C	49	B	50	B
51	B	52	B	53	B	54	B	55	C
56	B	57	B	58	B	59	B	60	B
61	B	62	B	63	B	64	B	65	B
66	B	67	B	68	B	69	B	70	B
71	B	72	B	73	B	74	C	75	B
76	B	77	C	78	B	79	B	80	B
81	B	82	B	83	B	84	A	85	B
86	B	87	C	88	B	89	B	90	B
91	B	92	B	93	B	94	C	95	B
96	B	97	B	98	B	99	B	100	B
101	B	102	B	103	B	104	B	105	B
106	B	107	B	108	A	109	C	110	B
111	B	112	B	113	B	114	B	115	B
116	B	117	B	118	B	119	B	120	B
121	B	122	B	123	B	124	B	125	B
126	A	127	B	128	B	129	B	130	B
131	B	132	B	133	B	134	B	135	B
136	B	137	A	138	B	139	B	140	B
141	B	142	B	143	B	144	B	145	B
146	B	147	B	148	B	149	B	150	B

151	B	152	B	153	B	154	B	155	B	156	B	157	B	158	B	159	B	160	B
161	B	162	B	163	B	164	B	165	B	166	B	167	B	168	B	169	B	170	B
171	B	172	B	173	B	174	B	175	B	176	B	177	B	178	B	179	B	180	B
181	B	182	B	183	B	184	B	185	B	186	B	187	B	188	B	189	B	190	B
191	B	192	B	193	B	194	B	195	B	196	B	197	B	198	B	199	B	200	B

Your Score	Result	Action
180–200 / 200	**Excellent**	Ready for Aramco Mechanical exam — review any incorrect answers
160–179 / 200	**Good**	Review weak sections and re-attempt before sitting the real exam
140–159 / 200	**Needs Work**	Re-study Parts 1-6 for all topics scored below 70%
Below 140 / 200	**Not Ready**	Complete full re-study of all Parts before attempting again