

Gas Turbine Repair & Refurbishment Workshop

No.	Machine / equipment	Representative manufacturer and model	Minimum capability / principal use	Qty.	Capacity / redundancy note
A	Receiving, traceability and material handling				
1	Double-girder bridge cranes	Demag V-type double-girder crane, 10 t and 20 t configurations	Variable-speed lifting; below-the-hook fixtures for baskets, nozzles, liners, transition pieces, buckets and vanes.	12 x 10 t; 4 x 20 t	Distributed bays; N+1 lifting coverage
2	Forklifts	Toyota 8FGU30 / 8FGU32 industrial forklifts	3.0-3.2 t class; fork positioner, non-marking tires and certified lifting attachments.	8	Receiving, WIP and shipping
3	Heavy autonomous mobile robots	MiR1350 AMR with MiR Pallet Lift 1350	Autonomous movement of fixtures and WIP up to 1,350 kg between production cells.	16	Supports three-shift flow
4	Vertical automated storage	Kardex Remstar Shuttle XP 1000	Controlled storage for tooling, gauges, consumables and serialized components; interface to MES.	10	Separate clean and dirty inventory
5	Floor scales	Mettler Toledo VFS floor scale, 3,000 kg configuration	Receiving/shipping verification; NTEP/legal-for-trade configuration where required.	8	One per major logistics zone
6	Serialization and laser marking	KEYENCE MD-X2500A hybrid laser marker	Permanent 2D Data Matrix/serial marking with vision alignment and traceability interface.	6	Controlled marking after incoming review
7	RFID/WIP tracking	Zebra FX9600 fixed RFID readers with RFD90 handheld readers	Part-route confirmation, fixture tracking and work-center transactions.	40 fixed; 20 handheld	Plant-wide digital traceability
B	Cleaning, coating removal and surface preparation				
8	Rotary aqueous parts washers	Better Engineering C-96 automated rotary basket washer	High-pressure heated wash/rinse; baskets sized for combustion and HGP components.	10	Parallel incoming and inter-operation cleaning
9	Large ultrasonic cleaning systems	Crest Ultrasonics custom 500-1,000 L console line	Multi-stage ultrasonic wash, rinse and hot-air dry; programmable chemistry and filtration.	8	Cooling-passage and precision cleaning
10	Robotic UHP waterjet stripping cells	Progressive Surface custom 5-axis robotic waterjet cell	Closed-loop 40-55 ksi class removal of TBC/oxides with part-specific recipes and water treatment.	8	Critical bottleneck; dedicate by part family

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11	Robotic grit-blast cells	Progressive Surface custom robotic grit-blast system	Controlled alumina media, pressure, stand-off and coverage; dust collection and media classification.	10	Pre-NDT and pre-coating preparation
12	Wet-blast cabinets	Guyson RSSA-8S automated wet-blast system	Non-aggressive cleaning and surface conditioning of complex hot-section geometries.	8	Reduces manual variability
13	Dry-ice cleaning units	Cold Jet Aero2 PCS 60	Adjustable particle size and dry cleaning for delicate deposits, tooling and localized work.	4	Supplemental non-abrasive cleaning
14	Laser-cleaning cells	cleanLASER CL 1000 robotic system	Localized oxide/coating removal with fume extraction and recipe control; no secondary media.	4	Selective preparation and R&D
15	Chemical stripping lines	KCH Engineered Systems custom multi-stage stripping line	Bunds, ventilation, temperature control, filtration, rinse cascade and chemical traceability.	4 lines	Segregate alloy/coating chemistries
16	Drying/curing ovens	Nabertherm TR 1050 forced-air oven	Uniform drying/low-temperature cure; programmable data logging and over-temperature protection.	8	Downstream of wash and masking
17	Central dust collectors	Donaldson Torit DFE 3-9 cartridge collector	HEPA final filtration where required; explosion protection matched to media risk assessment.	12	Dedicated collectors by media/process
C	Inspection and non-destructive testing				
18	Automated fluorescent penetrant inspection lines	Gould-Bass custom 6-stage Type I FPI line	Water-washable/post-emulsifiable capability, controlled dwell, wash, dry and developer; dark inspection booths.	6 lines	Nadcap-capable layout; parallel product streams
19	Magnetic-particle inspection benches	Magnaflux H-7000 wet horizontal MPI unit	AC/HWDC magnetization, UV inspection and current monitoring for ferromagnetic hardware.	6	For applicable steel components only
20	Digital radiography systems	Carestream INDUSTREX HPX-DR 3543 PE with 450 kV shielded cabinet	High-resolution DR, manipulator, image archiving and qualified IQI workflow.	4 cells	Licensed radiation area; N+1 capacity
21	Industrial computed tomography	Waygate Technologies phoenix v tome x L 450	Microfocus/minifocus CT for internal cooling passages, braze condition and complex cast features.	2	Reference lab plus production support
22	Eddy-current inspection instruments	Eddyfi Ectane 3 with surface-array and pencil probes	Multi-channel ECT for cracks, coating condition and near-surface discontinuities.	10	Portable and cell-based use

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23	Phased-array ultrasonic instruments	Eddyfi Gekko 64:128PR	PAUT/TFM for welds, buildups and thicker sections; encoded scanning kits.	8	Procedure-qualified applications
24	Conventional ultrasonic flaw detectors	Waygate Technologies Krautkramer USM 100	Portable UT with corrosion/thickness and flaw-detection probe sets.	10	Inspection and field support
25	Industrial videoscopes	Evident IPLEX One, 4.0/6.0 mm scope configurations	High-resolution remote visual inspection and 3D measurement of cooling passages and cavities.	12	Multiple diameters and spare insertion tubes
26	Digital inspection microscopes	Evident DSX1000	Extended-depth imaging, 2D/3D measurement and standardized defect documentation.	8	Incoming, in-process and final inspection
27	Helium leak detectors	Pfeiffer Vacuum ASM 340	Vacuum and sniffer modes for sealed components, test fixtures and cooling circuits.	8	Shared with final test; N+1
28	Cooling-air flow test benches	Custom PLC-controlled multi-channel sonic-nozzle flow benches	Mass-flow, pressure, temperature and back-pressure control; automated comparison to master parts.	12	Dedicated fixtures by turbine family
D	Welding, dimensional restoration and precision machining				
29	Automated GTAW repair cells	Liburdi Automated Welding Systems (LAWS), custom turbine configuration	Programmed weld buildup, AVC, wire feed, shielding and data capture for repeatable hot-section repairs.	12	Primary weld-buildup capacity
30	Manual precision GTAW stations	Fronius MagicWave 500i with cold-wire feeder	AC/DC TIG, pulsed control, water cooling, local extraction and purge-gas monitoring.	24	Complex localized and development repairs
31	Laser cladding/welding cells	TRUMPF TruLaser Cell 3000 with TruDisk 4001	5-axis laser deposition/welding, powder and wire feed options, coaxial process monitoring.	6	Low-heat-input restoration
32	Robotic blending and polishing cells	ABB IRB 6700 with PushCorp AFD310 compliant spindle	Force-controlled blending, deburring and polishing with offline programming and dust extraction.	12	High labor-saving priority
33	Dedicated turbine-blade 5-axis machining centers	Starrag LX 051	Simultaneous 5-axis adaptive machining for airfoils, tips and platforms; in-process probing.	8	Buckets/blades and smaller vanes
34	Production 5-axis mill-turn centers	Makino DA500 with APC/pallet automation	20,000 rpm class spindle, 5-axis milling and optional turning for complex production repairs.	8	Lights-out capable cell
35	Heavy-duty 5-axis machining centers	Makino D500 with MMC2 pallet automation	Thermally stable 5-axis machining for nozzles, transition pieces, liners, fixtures and larger components.	6	Large/complex repair geometry

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36	Turn-mill multitasking centers	Okuma MULTUS U4000	B-axis milling, C-axis turning and long-bed capability for sleeves, rings, shafts and tooling.	4	Tooling plus rotating/annular components
37	Five-axis EDM hole-drilling machines	Makino EDBV8	5-axis EDM drilling for cooling-hole restoration and complex angled holes in nickel superalloys.	8	Critical HGP throughput cell
38	High-precision sinker EDM	Makino EDAF3	Precision cavity/feature restoration, electrode automation and unattended operation.	4	Special features and tooling
39	High-speed wire EDM	Makino U6 H.E.A.T. Extreme	High-speed precision cutting, fir-tree/tooling work and difficult nickel alloys.	4	Production plus toolroom support
40	Five-axis abrasive waterjet cutting	Flow Mach 500 3020 with Dynamic Waterjet XD	5-axis cutting of sheet, fixtures, masks and replacement details without a heat-affected zone.	2	Toolroom/fabrication support
41	CNC cylindrical grinding	STUDER S41	High-precision OD/ID grinding with B-axis wheelhead and in-process measurement options.	4	Rings, pins, sleeves and tooling
42	CNC surface/profile grinding	BLOHM PLANOMAT XT 612	Precision plane/profile grinding for platforms, segments, fixtures and shims.	4	Parallel finish-grinding capacity
43	Five-axis grinding centers	MAGERLE MFP 30	Multi-process grinding with tool change and probing for difficult-to-machine hot-section alloys.	4	Profile/feature finish restoration
44	Abrasive-flow machining systems	Extrude Hone VECTOR 6	Controlled internal deburring, radiusing and flow-path polishing of cooling passages.	8	Dedicate media by alloy/application
45	Hydraulic straightening presses	Enerpac VLP 200-ton press, instrumented custom configuration	Load/displacement monitoring, guarded fixtures and controlled straightening of segments/components.	6	Engineering-approved repair routes only
46	Double-side lapping machines	Lapmaster Wolters AC 700	Precision flatness and parallelism restoration for seals, rings and mating faces.	4	Final dimensional finishing
47	Tool presetters	ZOLLER venturion 600	Tool measurement, balancing interface and tool-data transfer to CNC cells.	4	One per machining cluster
48	In-process comparative gauges	Renishaw Equator 500	High-speed shop-floor comparative gauging with automated loading options.	6	Protects CMM capacity
E	Heat treatment, brazing and thermal processing				
49	Production vacuum heat-treatment furnaces	Ipsen TITAN H6, 2-bar gas quench	36 x 36 x 48 in class hot zone; solution, age, stress relief and approved cycles to AMS2750 controls.	6	Core heat-treatment battery; N+1

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50	Vacuum brazing furnaces	Solar Manufacturing HFL-5748-2IQ	36 x 36 x 48 in class hot zone, automated recipes, high vacuum and controlled gas cooling.	4	Dedicated clean brazing furnaces
51	Large-load vacuum furnaces	Ipsen TITAN H8	48 x 48 x 80 in class hot zone for large transition pieces, liners, nozzle assemblies and fixtures.	4	Large-component parallel capacity
52	Forced-convection temper/dry ovens	Nabertherm N 1000/85 HA	Uniform low-/medium-temperature aging, tempering and bake-out with independent recorder.	8	Batch support and process segregation
53	Hot isostatic pressing system	Quintus Technologies QIH 48 M URC	HIP repair/densification of approved cast or additively restored components; rapid cooling.	2	Strategic/optional; justify by repair portfolio
54	Induction heating systems	Ambrell EKOHEAT 50/100	Controlled local preheat, braze and postheat with recipe storage and pyrometry.	6	Localized thermal processing
55	Inert-atmosphere retort furnaces	Lindberg/MPH custom 1,200 C retort furnace line	Argon/hydrogen-capable protective atmosphere, dew-point control and data acquisition.	6	Diffusion, bake-out and specialty cycles
56	Furnace survey/data-acquisition sets	Fluke Calibration 2638A Hydra Series III	Multi-channel SAT/TUS data acquisition with calibrated thermocouple interfaces.	12	Supports AMS2750/Nadcap discipline
F	Shot peening, diffusion treatment and thermal-spray coating				
57	CNC shot-peening cells	Progressive Surface PRIMS Pro robotic shot-peening system	Closed-loop media flow, Almen intensity, coverage control and serialized recipe reporting.	8	Critical fatigue-restoration process
58	Atmospheric plasma-spray cells	Oerlikon Metco UniCoatPro with TriplexPro-210	Robotic APS for bond coats/TBC; controlled powder, gases, stand-off and part motion.	8	High-throughput TBC cells
59	HVOF coating cells	Oerlikon Metco UniCoatPro with WokaStar-610	Robotic HVOF for dense metallic/carbide coatings with enclosed booth and dust handling.	6	Segregate chemistries and powder families
60	Vacuum plasma-spray systems	Oerlikon Metco custom VPS chamber with MultiCoat control	Low-pressure/vacuum plasma spray for high-integrity MCrAlY bond coats and specialty systems.	2	Strategic core for premium HGP capability
61	Electron-beam PVD coating systems	ALD Vacuum Technologies custom turbine-component EB-PVD line	Columnar ceramic TBC deposition, automated fixturing, source control and coating monitoring.	2 lines	Strategic/optional; major capital and IP package

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62	Vapor-phase aluminizing lines	SECO/WARWICK Vector 15.0VP with custom aluminizing retorts	Controlled diffusion coating cycles, gas handling, retort tooling and process data logging.	4	Dedicated by coating chemistry
63	Masking/coating preparation booths	Nordson Encore HD manual system in custom downdraft booths	Controlled mask application, localized spray work and filtered ventilation.	8	Support cells; not a substitute for robotic coating
64	XRF coating-thickness analyzers	Helmut Fischer XAN 250	Non-destructive coating thickness/composition with programmable stages and calibrated standards.	4	Lab and production verification
65	3D optical surface metrology	Zygo NewView 9000	Non-contact roughness, waviness, coating topography and wear measurement.	4	Coating development and final QA
G	Dimensional metrology and reverse engineering				
66	High-accuracy bridge CMMs	ZEISS PRISMO fortis 12/18/10 with VAST rotary table	Production-environment scanning, aerospace acceleration mode and automated fixture programs.	8	Two metrology rooms plus production support
67	Automated optical scanning cells	ZEISS ATOS ScanBox 6130	Robotized full-field 3D scanning for airfoils, segments and reverse-engineering comparison.	10	High-throughput incoming/final inspection
68	Large gantry CMM	ZEISS MMZ T, application-sized configuration	Large transition pieces, liners, nozzle rings, fixtures and assembled hot-section hardware.	2	Reference measurement; N+1
69	Laser trackers	FARO Vantage Max with 6Probe	Large fixture alignment, machine verification and assembly geometry.	4	Portable across shop bays
70	3D optical profilers	KEYENCE VR-6200	Rapid non-contact profile, height, radius and cross-section measurement.	8	Shop-floor defect and feature measurement
71	Contour/roughness systems	Mitutoyo Formtracer Avant FTA-C3000	Combined contour and surface-roughness evaluation of edges, seal lands and machined features.	6	Controlled metrology rooms
72	Roundness/cylindricity systems	Mahr MarForm MMQ 400-2	Form error, concentricity and runout of annular components, pins, sleeves and tooling.	4	Precision final inspection
73	Portable roughness testers	Mitutoyo Surftest SJ-500	Skidless surface roughness measurement with production-ready analysis and reporting.	8	Machining and coating cells

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74	Optical comparators	Mitutoyo PJ-A3000 with QM-Data	Fast profile inspection of small details, coupons, gauges and tooling.	4	Toolroom and inspection support
75	Electrical/calibration standards	Fluke Calibration 5522A multi-product calibrator	In-house verification of electrical instruments supporting NDT, furnaces and test benches.	2	Calibration lab; external traceability retained
H	Metallurgical and materials laboratory				
76	Metallographic abrasive saws	Struers Discotom-100	Controlled sectioning of superalloys, coatings, brazes and weld coupons with minimal deformation.	4	Dirty sample-preparation room
77	Hot mounting presses	Struers CitoPress-30	Programmable dual-cylinder mounting for repeatable metallographic sample preparation.	4	Parallel sample preparation
78	Automated grinder/polishers	Struers Tegramin-30	Recipe-controlled planar grinding and polishing for coating, weld and base-metal evaluation.	6	High sample throughput
79	Inverted materials microscopes	Leica DMI8 M	Brightfield/darkfield/DIC imaging, automated stitching and quantitative metallography.	4	Production and failure analysis
80	Field-emission SEM with EDS	Hitachi SU5000 with Oxford Instruments Ultim Max EDS	High-resolution fractography, coating morphology and elemental microanalysis.	2	One production support; one R&D/reference
81	X-ray diffractometer	Bruker D8 ADVANCE	Phase identification, residual-stress and coating/crystallography investigations.	1	R&D and failure analysis
82	Optical emission spectrometer	Thermo Scientific ARL iSpark Plus	Rapid alloy verification and chemistry analysis for incoming material and weld consumables.	2	N+1 analyzer availability
83	Carbon/sulfur analyzer	LECO CS844	Combustion analysis of carbon and sulfur in ferrous/nonferrous alloys.	2	Reference chemistry lab
84	Oxygen/nitrogen/hydrogen analyzer	LECO ONH836	Inert-gas fusion analysis for interstitial elements in superalloys and titanium alloys.	2	Reference chemistry lab
85	Automated micro/macro hardness systems	LECO AMH55 with LM248 and LV810 platforms	Automated Vickers/Knoop mapping and macro-Vickers testing of welds, coatings and heat-treated zones.	4	Parallel production release testing
86	Rockwell hardness testers	QATM Qness 150 R	Automated Rockwell testing with documented calibration and result export.	4	Production hardness verification
87	Universal testing machines	Instron 5985, 250 kN configuration	Tensile, compression, shear and coating/braze coupon testing with extensometry.	2	Mechanical test laboratory

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88	Servo-hydraulic fatigue tester	Instron 8801, 100 kN configuration	Low-/high-cycle fatigue and repair-process qualification coupons.	1	R&D/qualification, not routine release
89	Thermal analysis system	NETZSCH STA 449 F5 Jupiter	Simultaneous TGA/DSC for coating powders, binders, contaminants and process development.	1	R&D and process control
I	Final testing, preservation and digital production control				
90	Hydrostatic/pneumatic test skids	Resato HPU custom multi-station test systems	Guarded pressure testing with recipe control, calibrated transducers and automatic reports.	4 skids	Dedicated test bays and safety zoning
91	Final aqueous wash systems	Better Engineering C-96, final-clean configuration	Dedicated final cleaning with controlled chemistry, filtered rinse and cleanliness verification.	4	Physically separated from incoming wash
92	Final drying/bake-out ovens	Nabertherm TR 1050 clean final-process configuration	Filtered hot-air dry, programmable bake-out and recorded cycle data.	4	Clean final-processing area
93	VCI preservation/packing stations	Sealed Air custom VCI and barrier-bag packing cells	Humidity indicator, desiccant, vacuum sealing, serialized labels and export packing instructions.	8	Supports 4+ completed sets/day
94	Manufacturing execution system	Siemens Opcenter Execution Discrete	Electronic travelers, route enforcement, WIP, NCR, equipment status, SPC and full genealogy.	1 plant system	Essential for 1,000-set control
95	Engineering/CAD/CAM/PLM platform	Siemens NX, Teamcenter and VERICUT	Reverse engineering, repair models, CAM, configuration control and CNC simulation.	60 NX/CAM; 120 PLM; 20 VERICUT	Concurrent engineering and production support
J	Plant utilities, environmental controls and reliability support				
96	Oil-free compressed-air package	KAESER DSD 205 rotary screw compressors	Central 7-10 bar instrument/process air, sequenced controls, heat recovery and receiver capacity.	4 duty + 1 standby	N+1 utility design
97	Desiccant dryers	KAESER DC-series heat-regenerated desiccant dryers, application-sized	Pressure dew point suitable for coating, instrumentation and dry blasting; duplex filtration.	3 trains	N+1 dried-air capacity
98	Nitrogen generators	Parker NITROSource N2-45	High-purity nitrogen for furnaces, leak testing, preservation and process purging; bulk backup connection.	4	Duty/standby arrangement

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99	Central process chillers	Trane CenTraVac CVHF, application-sized	Redundant chilled-water loop for CNC, lasers, coating, vacuum furnaces and metrology HVAC.	3 duty + 1 standby	Final tonnage by heat-load study
100	Point-of-use temperature-control units	Thermal Care NQ Series	Dedicated cooling for lasers, EDM, thermal spray and sensitive production equipment.	12	Isolates critical process loads
101	Central fume extraction	Nederman FlexFilter EX	Modular extraction for welding, blending, blasting and powder handling with risk-specific fire/explosion controls.	4 systems	Separate incompatible contaminants
102	Industrial wastewater treatment	EnviroChemie Split-O-Mat SOM 3000	Batch treatment of wash/strip wastewater with pH control, precipitation, filtration and compliance sampling.	2 trains	Duty/standby; chemistry study required
103	Deionized-water plant	Veolia IonPRO LX skid, application-sized	RO/EDI production, storage and recirculation for final rinse, coating and laboratory use.	2 x 100% trains	Redundant high-purity water supply
104	Fixed gas detection network	MSA Ultima X5000	Oxygen deficiency, hydrogen, fuel gas and process-gas monitoring with alarm/ventilation interlocks.	Plant-wide network	Required around furnaces/coating/gas farm
105	Predictive-maintenance instruments	Fluke 3563 vibration sensors with 810 handheld analyzer	Condition monitoring for furnaces, pumps, compressors, blast systems and CNC auxiliaries.	80 sensors; 4 analyzers	Supports high OEE and planned maintenance



WEISS ScanBox 8