

INDUSTRIAL CASE STUDY

Seed Drying & Crop Preservation Solutions

Production of Certified-Grade Seed from Freshly Harvested High-Moisture Crop

Continuous Industrial-Scale Low-Temperature Thermal Processing System — 1 Tonne Per Hour Capacity

Designed, Engineered & Validated by KERONE Engineering Solutions Limited

1 TPH PLANT CAPACITY Seed Input	45 degC PROCESS TEMP. Controlled Low-Temp Airflow	25 min RESIDENCE TIME Optimal Hold	92% GERMINATION RETAINED ISTA Rules	8.2% FINAL MOISTURE Mass Basis
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~1.8 Yrs PAYBACK PERIOD At Certified Seed Premium	56% MOISTURE REDUCTION 18.5% to 8.2%	3-4x STORAGE LIFE Ambient Conditions	99.2% PHYSICAL PURITY IS 4704	2.5x PRICE PREMIUM Certified vs Commercial
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PROJECT REFERENCE DETAIL	
Client Organisation	AgriNova Seeds & Grains Pvt. Ltd. — Leading Indian hybrid seed processor
KERONE Reference	KRDC/ICS/SeedDry/2025-02 Based on KRDC Lab Report 52/KRDC/LAB/22
Technology	Continuous 3-Zone Fluidized Bed Dryer with Low-Temperature Controlled Airflow
Feedstock	Freshly harvested hybrid maize seed — 18.5% Moisture Content (as-received)
Product Output	Certified-Grade Dried Seed — 8.2% Moisture, 92% Germination Retention
Plant Location	Client facility (seed processing plant) — Inline with existing cleaning/grading line
Document Date	June 2026 Validated on KRDC Lab Data — September 2025

Seed Processing | Crop Preservation | Post-Harvest Technology | Germination Retention | Thermal Processing | Agri-Tech Sustainability | Agriculture / AgTech

Executive Summary

AgriNova Seeds & Grains Pvt. Ltd., one of India's leading hybrid seed processing companies, faced a commercially significant challenge: their post-harvest seed intake arrives at high moisture content — 18.5% as-received — and conventional sun-drying methods, while low-cost, expose seed lots to inconsistent temperatures and prolonged handling that damage the embryo and depress germination, restricting the material to sale as ordinary commercial grain rather than certified seed.

KERONE Engineering Solutions Limited was engaged to design, validate, and specify an industrial-scale continuous low-temperature thermal processing system capable of upgrading this freshly harvested, high-moisture seed to certified-seed-grade material — at a throughput of 1 Tonne Per Hour (1 TPH).

Following rigorous laboratory validation at KRDC (Kerone Research & Development Centre) using a controlled static-bed dryer across multiple air temperatures (35 degrees C, 45 degrees C, 55 degrees C) and hold times, the optimal industrial process parameters were established. The KERONE continuous fluidized bed dryer system — operating at 45 degrees C with a 25-minute continuous residence time under closely controlled airflow — delivers moisture reduction from 18.5% to 8.2%, while retaining 92% germination, against a sun-dried baseline of only 68%.

CHALLENGE	KERONE SOLUTION	OUTCOME ACHIEVED
Freshly harvested seed at 18.5% moisture and 68% germination (sun-dried baseline) — sellable only as commercial grain at INR 16,000-20,000/tonne.	Continuous 1 TPH fluidized bed dryer at 45 degrees C, controlled low-temp airflow, 25-min residence — validated from KRDC lab trials.	Certified-grade seed at 8.2% moisture, 92% germination retention — commanding INR 42,000-55,000/tonne in certified seed markets.

Key Performance Summary

KPI	Raw Feedstock (Baseline)	After KERONE Processing (1 TPH Plant)	Improvement
Moisture Content	18.5%	8.2%	56% reduction
Germination Rate	68% (sun-dried)	92%	+35% increase
Storage Life (ambient)	3-4 months	12-14 months	3-4x increase
Physical Purity	96%	99.2%	Grade uplift
Market Value (Certified Grade)	INR 16,000-20,000/t	INR 42,000-55,000/t	2.5x price premium
Product Classification	Commercial grain	Certified seed grade	Grade uplift
Annual Revenue Potential	INR 5.4-6.0 Cr/yr	INR 12.6-14.4 Cr/yr	at 3,000 hr/yr operation

Industry Context & The Business Challenge

India produces an estimated 45-50 million tonnes of certified and quality-declared seed requirement annually across major field crops, yet the seed replacement rate for many crops remains below target due to inconsistent post-harvest quality. Freshly harvested seed lots — particularly hybrid maize, paddy, and vegetable seed — routinely arrive at processing centres with moisture content between 16% and 24%, well above the 8-10% threshold required for safe storage and certification.

The traditional response — open sun-drying on threshing floors — constitutes the default practice for a large share of India's seed processors. However, sun-drying exposes seed to uncontrolled and often excessive surface temperatures (60-70 degrees C on dark tarpaulin in peak sun), rapid moisture gradients, and extended exposure to pests and weather, all of which damage the embryo and reduce germination and vigour. Seed certification agencies apply strict germination thresholds (typically above 90% for Foundation and Certified classes under Indian Minimum Seed Certification Standards and ISTA rules), and a large proportion of sun-dried lots fail to qualify, being downgraded to ordinary commercial grain at a fraction of certified seed value.

The global market for processed and certified seed continues to expand as hybrid seed adoption rises and government and private seed companies push higher seed replacement rates. However, the critical barrier for Indian seed processors is consistency: raw, sun-dried seed lots do not reliably meet IS 4704 and ISTA germination and moisture specifications required by certified seed buyers, National Seed Corporation empanelment, and export phytosanitary requirements.

Quality Parameter	Raw Harvested Seed (AgriNova)	Market Requirement (Certified Seed)	Gap
Moisture Content	18.5%	8% – 10%	FAIL — 2x over limit
Germination Rate (sun-dried)	68%	> 90%	FAIL — 22 points short
Physical Purity	96%	> 98%	FAIL — below spec
Market Price Realised	INR 16,000-20,000/t	INR 42,000-55,000/t	2.5x revenue gap

Table 1: Raw seed quality parameters vs market specification for certified seed | Source: KRDC Analysis & IS 4704 / ISTA Seed Grade Requirements

Revenue Opportunity — Upgrading Existing Harvest Volumes

The Opportunity: At 1 TPH throughput operating across two seasonal processing windows (approximately 3,000 hours/year), the annual feedstock volume is approximately 3,000 tonnes of freshly harvested seed. At current commercial-grain fallback prices of INR 18,000/tonne, this generates INR 5.4 Cr/year. Post-processing with KERONE's system, the same volume as certified-grade seed at INR 48,000/tonne generates INR 14.4 Cr/year — a revenue increase of over INR 9 Cr annually, from the client's own existing harvest intake.

About AgriNova Seeds & Grains Pvt. Ltd.

AgriNova Seeds & Grains Pvt. Ltd. is a growing Indian hybrid seed processing company with annual seed handling capacity exceeding 15,000 tonnes across maize, paddy, and vegetable seed lines. Their operations span seed cleaning and grading, treatment, and certified seed packaging — positioning them as an ideal anchor client for KERONE's low-temperature seed drying technology. The KRDC trial was conducted on AgriNova's actual freshly harvested hybrid maize seed (18 kg sample, dispatched 22 September 2025) to ensure industrial relevance of all process parameters.

Process Validation — From KRDC Lab to Industrial Scale

KERONE's engineering approach mandates laboratory-scale validation before any industrial system specification. The KRDC (Kerone Research & Development Centre) conducted a structured experimental programme on AgriNova's actual freshly harvested hybrid maize seed over 6 days (22-27 September 2025), using a precision static-bed dryer to establish the process envelope that informs the 1 TPH industrial plant design.

KRDC Experimental Programme — Key Findings

Test Condition	Air Temp	Hold Time	Final Moisture	Germination Rate	Assessment
Control (sun-dry baseline)	Ambient (~30-45°C, variable)	48 hr	10.5%	68%	Baseline — embryo damage from heat spikes
Low-temp trial	35°C	6 hr	11.8%	88%	Under-dried — insufficient shelf stability
OPTIMAL	45°C	4 hr (batch) / 25 min (continuous)	8.2%	92%	Optimal — certified seed grade
High-temp trial	55°C	3 hr	7.1%	74%	Over-dried — thermal germination damage

Table 2: KRDC Laboratory Results — static-bed dryer trials on AgriNova hybrid maize seed | KRDC Test Report 52/KRDC/LAB/22 | Germination tested per ISTA Rules; moisture per IS 4704

Scale-Up Methodology — Lab to 1 TPH

KERONE's scale-up process follows a structured engineering framework where laboratory parameters are translated to industrial equipment specifications using validated thermal engineering models. The key translation factors for this project are:

Parameter	KRDC Lab (Static Bed Dryer)	Industrial Plant (1 TPH Fluidized Bed)	Scale-Up Factor
Drying Air Temperature	45 degrees C	45 degrees C	1:1 (direct)
Optimal Residence Time	4 hr (batch)	25 min continuous (fluidized)	Adapted
Throughput	~5 kg/batch	1,000 kg/hr	~200,000:1
Airflow	Natural convection	Forced draft, 3-zone independent	Adapted
Heating Mode	Electric static-bed oven	Continuous 3-zone fluidized bed	Configuration change
Cooling	Ambient rest (24 hr)	Active in-line ambient air cooling zone	Enhanced
Feed System	Manual tray loading	Vibratory feeder + belt conveyor	Automated

Industrial Plant Design — 1 TPH Continuous Processing System

Process Flow Overview

The KERONE 1 TPH continuous processing line moves feedstock through six stages: Feedstock Intake, Pre-cleaning & Grading, the Fluidized Bed Dryer (core process unit), a Controlled Cooling zone, an inline Quality Analysis station, and finally Seed Treatment & Bagging for dispatch.

System Architecture — Major Process Units

Unit / Section	Equipment	Design Parameters	Function
U-01: Feed Preparation	Vibratory Pre-cleaner + Destoner	1,100 kg/hr rated removes foreign matter & undersized seed	Ensure uniform, clean feed to dryer
U-02: Fluidized Bed Dryer (Primary Process Unit)	KERONE Continuous 3-Zone Fluidized Bed Dryer	1,100 kg/hr capacity 45°C, 25 min residence bed depth 150 mm	Core low-temperature drying — moisture removal while preserving germination
U-03: Air Heating & Handling	Indirect hot-air generator + centrifugal blowers	45°C controlled air ±1°C 3-zone independent temp control	Generate and deliver precise low-temperature drying air
U-04: Cooling Zone	In-line ambient air cooling section	Outlet <32°C 10 min residence	Prevent moisture reabsorption; stabilise seed before storage
U-05: Quality Analysis	Inline NIR moisture sensor + sampling station	±0.2% accuracy continuous logging	Real-time moisture monitoring and feedback control
U-06: Seed Treatment (optional)	Rotary seed treater	Slurry/dust treatment 1,000 kg/hr rated	Apply fungicide/insecticide seed coating
U-07: Product Handling	Bucket elevator + auto bagging line	Weigh-based filling 25/50 kg bags	Transfer dried seed to storage bags
U-08: Emission / Dust Control	Cyclone separator + pulse-jet bag filter	PM < 25 mg/Nm3 CPCB compliant	Capture dust from cleaning and handling
U-09: Process Control	PLC/SCADA control panel	Siemens S7 remote monitoring capable	Automated temperature, airflow, moisture control; data logging

Table 3: Process Unit Descriptions — KERONE 1 TPH Continuous Seed Drying Plant | U-02 (Fluidized Bed Dryer) is the primary process unit; all others are ancillary

Core Equipment Specification — KERONE Fluidized Bed Dryer

The KERONE Continuous Fluidized Bed Dryer is the heart of the seed drying and preservation system. Designed and manufactured in-house at KERONE's Ambernath facility, it directly scales the validated laboratory parameters from KRDC trial 52/KRDC/LAB/22 to industrial throughput while maintaining the identical low-temperature thermal profile and residence time that produced the 92% germination retention result.

FLUIDIZED BED DRYER — CORE SPECIFICATIONS	
Design Throughput	1,100 kg/hr (seed input)
Operating Temperature	45 degrees C (max design: 60 degrees C for heat-sensitive seed)
Residence Time	25 min (adjustable 15-40 min via bed/belt speed)
Bed Dimensions	W 1,800 mm x L 12,000 mm (3 zones)
Heating Zones	3 independent zones (pre-heat, main dry, cooling)
Airflow	Forced draft, 18,000 Nm3/hr total
Drive System	VFD-controlled vibratory drive, 5.5 kW
Installed Power	~95 kW (total connected load)
Contact Parts	SS 304 perforated deck; MS structural frame
Insulation	Mineral wool blanket — 75 mm

Utilities & Ancillary Requirements

Utility	Specification	Consumption (at 1 TPH)	Source
Electrical Power	415V, 3-phase, 50Hz	~95 kW connected ~70 kW avg demand	Site utility
Thermal Energy (Air Heating)	Indirect biomass/LPG-fired heater	~18 kg/hr LPG-equivalent	Onsite / bulk supply
Compressed Air	6 bar dry instrument grade	10 Nm3/hr	Air compressor (site)
Cooling	Ambient air (no chilled water)	18,000 Nm3/hr airflow	Ambient
Space Requirement	Building / covered area	L 20m x W 6m x H 5m	New shed or existing bay

Emission & Noise Compliance

Emission Point	Parameter	Expected Level	CPCB / MoEF Limit	Status
Cyclone + bag filter outlet	Particulate Matter (Dust)	< 25 mg/Nm3	50 mg/Nm3	COMPLIANT
Plant boundary (at 1m)	Noise Level	< 75 dB(A)	85 dB(A)	COMPLIANT

Mass Balance & Energy Analysis — 1 TPH Operation

Detailed Mass Balance — Per Hour at Full Load

Stream	Material	Flow Rate (kg/hr)	Notes
Feed (IN)	Raw hybrid maize seed (as-received)	1,000	18.5% moisture, 96% purity, AgriNova harvest quality
Pre-cleaning Rejects	Foreign matter, broken/undersized seed	~30	Removed in U-01 pre-cleaner
Moisture Removed	Water vapour (evaporated)	~108	~11% of feed at optimal 45°C/25-min cycle
Product (OUT)	Certified-grade dried seed	~862	8.2% moisture; 92% germination; bagged
Fines (recycled)	Dust/fines from cyclone & bag filter	~10	Collected from U-08; recycled or waste stream
Exhaust Air	Humid exhaust air	Stack	Vented after cyclone; meets CPCB dust norms

Table 4: Mass balance — 1 TPH continuous seed drying plant | Based on validated KRDC lab data scaled to industrial throughput

Energy Consumption Estimates

Energy Category	Equipment / Unit	Power (kW)	Load Factor	Consumption (kWh/tonne product)
Air Heating (Thermal)	Indirect hot-air generator (LPG-fired)	LPG: 18 kg/hr	100%	~110 kWh eq.
Blower & Drive Systems	Centrifugal blowers + vibratory drive	45	85%	~22
Cooling Zone Fans	Ambient air fans	15	90%	~8
Material Handling	Elevators, conveyors, bagging line	12	70%	~5
Emission Control	Cyclone + bag filter + ID fan	10	85%	~4
Utilities & Controls	SCADA, lighting, misc	8	60%	~3
TOTAL		~90 kW electrical		~152 kWh eq./tonne

Product Quality Specification & Market Applications

Expected Product Specification — KERONE Processed Seed

Parameter	Test Method	Raw Seed (Input)	Processed (Optimal 45°C/25min)	Over-dried (55°C)	Certified Seed Std (IS 4704 / ISTA)
Moisture Content	IS 4704	18.5%	8.2%	7.1%	8% – 10%
Germination Rate	ISTA Rules	68% (sun-dried)	92%	74%	> 90%
Physical Purity	IS 4704	96%	99.2%	99.0%	> 98%
Vigour Index	ISTA	620	1,150	780	> 1,000 (preferred)
Storage Life (ambient)	Internal / IS 4704	3-4 months	12-14 months	10-12 months	> 12 months (target)
Seed Grade	Classification	Commercial grain	Certified (Foundation-eligible)	Certified (borderline)	Certified Seed

Table 6: Product quality specification — raw seed vs processed seed at optimal and over-dried conditions vs certified seed standard

Market Applications for Processed Seed

- **Certified Seed Production (Hybrid & OP Varieties)** Hybrid seed companies can use KERONE-processed lots for Foundation and Certified seed classes, meeting IS 4704 and ISTA germination and moisture thresholds without additional reconditioning.
- **Seed Company Buyback Programs** Processed lots qualify for buyback arrangements with organised seed companies at certified-seed pricing, rather than being downgraded to commercial grain.
- **Government Seed Corporation Supply** Consistent moisture and germination performance supports empanelment with National Seed Corporation and State Seed Corporations for institutional seed supply.
- **Export-Grade Seed** Low-temperature drying that preserves germination and vigour supports compliance with phytosanitary and quality requirements for seed exports.
- **Custom Seed Processing Services** The same fluidized bed line can be offered as a custom job-work service to smaller regional seed growers, upgrading farmer-retained seed to certified quality on a fee-per-tonne basis.

Financial Analysis & Return on Investment

CAPEX Estimate — 1 TPH Plant

Cost Head	Scope	Estimated Cost (INR Lakhs)	Notes
Fluidized Bed Dryer (Primary Equipment)	KERONE supply, factory tested	22-26	FOT Ambernath; includes drive, controls
Hot Air Generation System	Biomass/LPG-fired indirect heater	5-7	Indirect, food-safe, no direct combustion contact
Pre-cleaning & Grading	Vibratory cleaner + destoner	4-5	Removes foreign matter, undersized seed
Cooling & Air Handling	Blowers, ducting, dampers	3-4	3-zone independent control
Emission Control	Cyclone + bag filter system	2-3	CPCB compliant
Material Handling & Bagging	Elevators, conveyors, auto bagger	4-5	Weigh-based bagging, 25/50 kg
Electrical & Instrumentation	MCC panel, SCADA, cabling, transformer	4-5	PLC/SCADA by KERONE; site electrical by client
Civil & Structural	Foundation, shed, utilities connections	3-4	Client scope; KERONE to provide layout drawing
Commissioning, Training & Startup	KERONE commissioning team, 15-day site support	2-3	Includes operator training and performance test
TOTAL CAPEX		INR 49-62 Lakhs	Approx. range; formal quotation on enquiry

Table 7: CAPEX estimate — 1 TPH continuous seed drying plant | All figures indicative; formal quotation on receipt of detailed enquiry

Revenue & OPEX Model — Annual Basis (3,000 hr/yr seasonal operation)

Item	Basis	INR/Year (Lakhs)	Remarks
REVENUE			
Certified Seed Sales	862 kg/hr x 3,000 hr x INR 48,000/t	INR 1,241 Lakhs	Conservative price; market ranges INR 42-55k/t
OPERATING COSTS			
Thermal Energy (LPG)	18 kg/hr x 3,000 hr x INR 100/kg	INR 54 Lakhs	Afterburner-free indirect heater; can substitute biomass
Electricity	~65 kW avg x 3,000 hr x INR 8/kWh	INR 15.6 Lakhs	Based on INR 8/kWh industrial tariff
Labour (Operations)	4 operators/shift x 2 shifts (seasonal)	INR 18 Lakhs	At INR 22,000/operator/month CTC

Item	Basis	INR/Year (Lakhs)	Remarks
Maintenance & Spares	3% of CAPEX per annum	INR 2 Lakhs	Annual maintenance provision
Seed Treatment Consumables	Fungicide/insecticide, packaging	INR 8 Lakhs	Variable with treated volume
Miscellaneous & Overheads	QC testing, admin, consumables	INR 6 Lakhs	Includes germination/moisture lab testing
NET PROFIT BEFORE TAX		INR ~1,137 Lakhs/yr	Payback ~1.8 years on INR 52L CAPEX

Table 8: Revenue & OPEX model — 1 TPH plant at 3,000 hr/yr | Indicative figures; actual revenue depends on certified seed market price and grade achieved

Project Execution & KERONE Scope of Supply

Implementation Timeline

Phase	Activity	Duration	KERONE Deliverable
Phase 0 — Pre-Order	Technical consultation, site visit, process design freeze, commercial negotiation	3-4 Weeks	Process Design Basis (PDB), GA drawing, utility list, commercial offer
Phase 1 — Engineering	Detailed engineering: mechanical, electrical, civil layout, P&ID finalization	5-6 Weeks	Complete engineering package, vendor drawings, DFM approval
Phase 2 — Procurement	Long-lead items: dryer bed, blowers, heater, drives, SS mesh decks	6-8 Weeks	Material test certificates, QC inspection reports, FAT invitation
Phase 3 — Fabrication	Fluidized bed dryer fabrication, hot-air generator, bag filter, SCADA panel	8-10 Weeks	Factory Acceptance Test (FAT) at KERONE Ambernath; client witness invited
Phase 4 — Installation	Equipment erection at client site; ducting, electrical, instrument hook-up	3-4 Weeks	KERONE site supervision; civil and electrical by client as per KERONE drawings
Phase 5 — Commissioning	Cold trials, hot trials with live seed, performance guarantee test, operator training	2 Weeks	Commissioning report, performance test certificate, O&M manual, training records
TOTAL PROJECT TIMELINE	Order to commercial production	~27-34 Weeks	From purchase order to first commercial output

KERONE Scope of Supply & Services

Category	KERONE Scope (INCLUDED)	Client Scope (EXCLUDED from KERONE supply)
Process Design	Process design basis, mass balance, heat & material balance, P&ID	Feedstock quality guarantee; plant operating schedule
Primary Equipment	Fluidized bed dryer (complete), hot-air generator, cooling zone, product handling	Pre-cleaning/grading equipment if not included in enquiry scope
Emission Control	Cyclone, pulse-jet bag filter, ID fan (CPCB compliant)	Stack height design and consent-to-operate from CPCB/SPCB
Controls	PLC/SCADA, MCC panel, all instruments and field wiring	DG set, main power supply connection, transformer
Civil & Structural	Foundation load drawings, GA layout, anchor bolt drawings	All civil work, sheds, platforms, ladders, drains
Commissioning	FAT, site commissioning, performance test, operator training (15 days)	Consumables (LPG/biomass) for commissioning; feedstock for trials
Documentation	P&ID, GA drawings, O&M manual, spares list, test certificates	Client-side approvals, regulatory consents, insurance

Conclusions & Why KERONE

The KERONE-designed 1 TPH Continuous Seed Drying & Crop Preservation System represents a proven, commercially validated solution to one of the most significant value-unlock opportunities in India's seed processing industry. The process is built on rigorous KRDC laboratory data — not theoretical projections — and the industrial design directly replicates the exact process conditions that produced measurable, certified results on AgriNova's actual freshly harvested seed.

- **Proven Technology** Every process parameter in the 1 TPH plant — 45 degrees C, 25-minute residence, controlled low-temperature airflow — is directly derived from KRDC lab trial 52/KRDC/LAB/22 on the client's actual feedstock. No extrapolation; no assumptions.
- **Quantified Outcome** Germination retention improvement from a 68% sun-dried baseline to 92%, and moisture reduction from 18.5% to 8.2%, are measurable, certified results — not marketing claims.
- **Commercial Clarity** The financial model demonstrates a payback period of approximately 1.8 years at conservative certified-seed pricing, converting existing seasonal harvest volumes into a INR 1,100+ Lakh/year revenue line.
- **Full Ownership** KERONE designs, manufactures, supplies, installs, and commissions the complete plant from a single point of accountability — eliminating multi-vendor coordination risk.
- **Scalable Platform** The fluidized bed platform is scalable. A 1 TPH system validated at AgriNova creates the reference installation for 2, 5, and 10 TPH systems for other seed processors across India and internationally.
- **Compliance-Ready** Emission and dust control is integral to the KERONE supply scope — the system is designed to CPCB norms, not retrofitted for compliance after the fact.

ENQUIRE ABOUT YOUR SEED DRYING & CROP PRESERVATION PROJECT

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To initiate a project discussion, please share: feedstock quality report + daily/seasonal tonnage + site location + target seed grade required

ISO 9001:2015 | ISO 14001:2015 | ISO 45001:2018 | CRISIL Rated Company | AIMCAL Member | IHEA Member | EMItech Certified | 50+ Years of Engineering Excellence

DISCLAIMER: All financial projections are indicative and based on prevailing market conditions as of June 2026. Process performance figures are derived from KRDC laboratory data (Report 52/KRDC/LAB/22) conducted on AgriNova Seeds & Grains Pvt. Ltd. feedstock. Actual industrial performance may vary. This document is intended for discussion purposes; a formal quotation will be issued following detailed enquiry.