Specification NS.1758
Issue 8

DOUGLAS-KALMAR TBL-280 TUGMASTER

TOWBARLESS AIRCRAFT HANDLING TRACTOR

FOR PUSHBACK INTER-GATE AND HIGHER SPEED, LONGER DISTANCE, MAINTENANCE TOWING OPERATIONS

DOUGLAS-KALMAR TBL-280 TUGMASTER

The Douglas-Kalmar TBL-280 Tugmaster, has been designed primarily for pushback, inter-gate towing, and longer distance maintenance towing operations at higher speeds, with aircraft with nose wheel weights up to 35 tonnes.
It dispenses with the need for a towbar by docking with and lifting the nose wheel of the aircraft, making one man pushback and towing operations possible.
This together with the simplicity of design, low maintenance and running costs, provides ground handling companies and airlines with significant opportunities to reduce operational costs with improved flexibility over and above conventional aircraft towing tractors and other towbarless towing concepts.

Aircraft that can be handled include, but is not limited to, fully laden: -

Embraer:	ERJ 170/175/190/195
McDonnell Douglas:	DC9/MD80/MD90.
Boeing:	B717, B737, B727, B757, B767 and B777.
Airbus:	A318/A319/A320/A321, A310/A300, A330 and A340-200/300.
Boeing:	DC10/MD11.
Lockheed:	L-1011.

SPECIFICATION

DIMENSIONS & WEIGHT:	Length:	8430 mm
	Width:	3400 mm
	Height over Cab:	2000 mm
	Ground Clearance:	180 mm
	Wheelbase:	4100 mm
	Turning Circle Radius: [unladen in 4 wheel steering]	8050 mm [Over body]
	Weight:	16,000 kgs
CHASSIS FRAME:	Robustly constructed welded chassis frame assembly with fabricated heavy duty steel longitudinals and crossmembers.	
ENGINE:	Type:	**Deutz** water cooled, turbocharged and inter-cooled, diesel engine to current exhaust emission standards to EU stage III / EPA Tier 3.
	Model:	TCD 2013 L6
	No. of cylinders:	6 in line
	Stroke:	126 mm
	Bore:	98 mm
	Capacity:	7.142 litres
	Max Power Rating:	190 kW (255 bhp) @ 2300 rpm
	Max Torque:	1000 Nm @ 1500 rpm
COOLING:	Engine/Transmission/ Hydraulics:	Heavy duty remote mounted cooling package comprising:- • Hydraulically driven, electronically controlled fan. • Radiators (2) for cooling transmission and hydraulics. • Charge air inter-cooler.
ENGINE PROTECTION:	Shutdown system, with over-ride facility, to monitor: - - High engine water temperature. - Low engine oil pressure.	
INDUCTION:	Air Cleaner:	Heavy duty dry type air cleaner.

EXHAUST: ***Standard:*** Type/Outlet: Stainless steel exhaust system routed to the side of the tractor.

Optional: Purifier: Catalytic exhaust purifier fitted in the exhaust outlet pipe.

TRANSMISSION: Engine mounted, ZF 3WG211 series powershift transmission incorporating torque converter and 3 speed forward, 3 speed reverse gearbox.

Normal operation: -

1st Gear: For pushback and inter-gate towing with heavier weight aircraft.

2nd Gear: For pushback and inter-gate towing with lighter aircraft and maintenance towing with larger aircraft.

3rd Gear: For pushback and inter-gate towing with smaller aircraft and maintenance towing with lighter weight aircraft.
Also travelling solo.

A forward/reverse inhibitor mechanism is fitted to prevent direction changes until the tractor is brought to rest and is stationary.

The Maximum Tractive Effort that can be produced, in any gear, is below the shear pin values of a conventional towbar used to handle the same range of aircraft. This ensures maximum protection for the aircraft being handled.

PROPELLER SHAFT: Needle roller bearing universal type propeller shafts coupling the engine/transmission to the front drive axle.

DRIVE/STEER AXLE: Kessler LT81 heavy duty double reduction front drive/steer axle incorporating differential lock.

Axle rigidly mounted to chassis frame.

WHEELS & TYRES: (Drive/steer axle) 445/65 R22.5 single pneumatic tyres on heavy duty wheel rims.

SUPPORT WHEELS: 7.50 R15 twin industrial pneumatic tyres on heavy duty wheel rims.

Fully braked wheel hubs mounted on hydraulically steered turntables independently connected to the chassis frame with trailing arm type air suspension system.

STEERING: **'**Mobil Elektronik' - electronically controlled full power assisted hydrostatic steering system providing selectable 4 mode steering: -

(i) Front two (2) wheel steering.

(ii) Rear two (2) wheel steering.

(iii) Four wheel (4) co-ordinated steering.

(iv) Crab steering.

Steering Cylinders: Double acting hydraulic steering cylinders mounted to drive/steer axle and support wheel assemblies.

Hydraulic Pump: Engine driven load sensing variable displacement pump.

EMERGENCY HYDRAULIC PUMP: Electro/hydraulic pump fitted to provide standby hydraulic power for steering and operation of aircraft nose wheel cradle system in the event of engine failure.

An additional manual/hand pump is provided to be able to operate the cradle functions in the event of engine and electrical failure.

HYDRAULIC SYSTEM:

Large capacity reservoir, with sight level gauge and gauze strainer.

Full flow 10 micron pressure filter in pump output line with visual serviceability indicator.

In-line system pressure gauge and individual circuit pressure regulator valves.

Easily accessible solenoid operated hydraulic control valves for each individual circuit, banked together, with manual overrides for emergency operation. Control valves fitted with pilot operated non-return valves for maximum safety. High pressure hydraulic hoses fitted throughout.

BRAKES:

Service:

Foot pedal operated dual circuit system, with independent circuits to front drive axle and rear support wheels.

Front Drive/Steer Axle Support Wheels

Air/hydraulic braking to the steer/drive axle which is fitted with oil immersed disc brakes.
Full air operated drum brakes.

Braking system air pressure automatically reduces when the tractor is coupled to the smaller range of aircraft.
This ensures that the maximum braking forces produced are always below the shear pin values of conventional towbars, used to handle the same range of aircraft, and affords maximum protection for the aircraft being handled.

Parking/Emergency:

Spring on/air off brake chamber fitted to transmission brake.

COMPRESSOR AND SYSTEM:

High output engine driven compressor feeding large capacity reservoirs for independent service/parking brake systems and air suspension systems.
All reservoirs fitted with non-return valves.

Air drier incorporated in system.

FUEL SYSTEM: Fully filtered fuel system with a 270 litres capacity fuel tank. Mechanical lift pump mounted on engine.

ELECTRICS: 24 volt electrical system incorporating:

- CAN-Bus controlled PLC – Programmable logic control of cradle functions, drive line and vehicle controls.
- Starter motor with interlock, to prevent cranking when the engine is running.
- Alternator - 110 amp capacity.
- Working light for cradle.
- Working lights for wing tip illumination.
- Head lights & Side lights for both driving directions.
- Stop/tail lights mounted at the rear and front of the tractor, and at rear cab roof level (for both driving directions.)
- Flashing direction indicators
- Warning horn
- Flashing amber warning beacon on cab roof.
- Hazard warning lights.
- Interior cab light
- Heavy duty batteries on slide out battery tray.
- Windscreen wipers and washers for front and rear screen.
- Reversing warning buzzer for both driving positions.
- Reversing lights for both driving positions.
- Automatic logic lighting changeover.
- Battery isolation switch.
- Emergency engine shutdown switches strategically positioned.
- Cab roof mounted proximity switches.
- Inter-vehicle start socket [Anderson type]

INSTRUMENTS: Indirectly illuminated instrument panel incorporating:

Electronic gauge unit with graphic display positioned on the driver's console to provide the following functions: -

- Air pressure (4 lines) with warning light and buzzer
- Engine water temperature
- Engine oil pressure
- Transmission oil temperature
- Fuel gauge with low level warning light
- Engine hour meter
- Battery voltmeter
- Tachometer
- Steering mode display
- Clock with time and date
- Gearshift information (confirmation of gear selected)
- Park brake warning
- NLG weight
- NLG loaded/unloaded indication
- Active text messages for driver information

PLUS Speedometer
Ignition key and push button start switch.
Transmission oil pressure warning light
No charge warning light
Indicator warning light
Flashing beacon warning light switch.
Cradle warning lights
Switch gear

CAB: Fully enclosed sound insulated dual control dual facing fully suspended cab, with centre swiveling seat / control column console to enable the operator to face in either direction of travel.
Cab of stylish and spacious design, manufactured from hollow steel sections with the structure skinned in heavy gauge steel sheet, for maximum strength, and with a reinforced laminated GRP roof.

Cab features include: -

- Adjustable steering column.
- All controls ergonomically positioned for ease of operation
- Air suspension system to provide unrivalled comfort, to reduce driver fatigue, and hence improve operational efficiency.
- Double glazed screens front and rear.
- Single glazed side windows and roof window for maximum vision.
- Tinted glass is fitted as standard.
- High output heater/demister.
- Spacious and well upholstered interior.
- Interior cab mirror.

SEATING: Adjustable air suspension seat for driver and adjustable air suspension seat, for occasional use, for one crew member.
Lap type seat belts are fitted for both seats.

DRIVING MIRRORS:

Standard: External rear view mirrors on both sides of the tractor for forward facing operations.

Optional: Electrically heated and adjustable rear view mirrors.

CLOSED CIRCUIT TELEVISION:

Standard: A CCTV system is fitted with a monitor in the cab and 2 cameras. This enables the operator to view all docking and cradle operations.

Optional: Additional camera – 3 camera system.
As above, with additional camera positioned at the rear of the tractor, to view the blind side of the aircraft.

BODYWORK: Main covers for engine / transmission, GPU compartment, support wheels, electrical box and PLC's are manufactured and styled in heavy duty fibre glass or aluminium construction.

All covers are designed to provide wide opening access, for ease of maintenance and repair.

INTERCOM and RADIO EQUIPMENT: Provision is made for the fitting of Intercom and VHF radios.

Intercom jack plug sockets are fitted in the cab and to each side of the tractor. [Total 5 nos.]

TOWING ATTACHMENT: A towing pintle is fitted at the front of the tractor for pushback operations, with a conventional towbar, of aircraft up to 50,000 kgs maximum take-off weight.
[Fokker F70/F100 or lighter]

Towing eyes are fitted at the rear of the tractor for recovery purposes only.

JACKING: *Standard*: Jacking points are incorporated to the front, rear, and sides of the tractor, designed such that most standard jacks of adequate capacity can be used.

Optional: An integral powered hydraulic jacking system can be incorporated, in addition to the standard jacking points.

Four hydraulic rams are fitted in the chassis frame, one at each wheel station. They operate in pairs to raise either the front or rear of the tractor and the lift of the rams is sufficient to allow wheel and tyre replacement in the event of a flat tyre.

Lock valves are incorporated in the hydraulic rams to prevent them lowering. This ensures absolute safety in the event of a hydraulic pipe failure.

CRADLE and LIFTING GEAR:

The tractor docks with the aircraft's nose wheel by means of lowering and opening an hydraulically operated cradle. The cradle comprises of a scoop and locking gate which can be adjusted to suit different nose wheel diameters.

When the cradle is closed and the gate locked, with the aircraft's nose wheel in position, front and rear transverse safety bars adjust to, and make contact with, the aircraft's tyres. This holds the nose wheel in position.

The locking gate itself has a very low height lifting surface to allow for obstructions that may be fitted to some types of aircraft.

Once docked and locked in position the aircraft's nose wheel is then only lifted 280 mm. This is by means of the cradle's hydraulically operated raise and lower cylinders and provides the weight for traction.

The cradle assembly automatically adjusts to cater for the geometric paths taken by non-perpendicular nose wheel struts during turning manoeuvres.

DOCKING:

Docking of the tractor to the nose wheel can be performed just before departure or while the aircraft is being boarded, since it is achieved without lifting or moving the aircraft, thus saving time and enabling much greater utilization of the tractor.

The aircraft's nose wheel is then only lifted and the pushback commenced, when the passenger boarding bridge or stairs are withdrawn.

On completion of the pushback or towing operation, the cradle is lowered, the safety bars released, and the locking gate opened. This allows the tractor to disengage from the aircraft.

CHASSIS LUBRICATION:

Automatic chassis lubrication - centralised greasing system, is fitted as standard.

SAFETY FEATURES:

* Low tare weight ensures inertia and frictional forces are kept to an absolute minimum, under all conditions.

* Low lifting height.

* Moderate engine power.

* Gearshift inhibit mechanism prevents gear selection unless the tractor is stationary.

* Controlled operational speeds.

* Maximum tractive efforts below shear pin values of conventional towbars.

* Maximum braking forces below shear pin values of conventional towbars.

* Smooth torque converter power take-up.

* Reduced tractive efforts and braking forces when tractor is coupled to smaller range of aircraft.

* Proportional hydraulic valves ensure safe and smooth handling of aircraft.

* Fail safe hydraulic locks and pneumatically operated mechanical lock prevents unintentional opening of the safety bars and locking gate when the cradle and nose wheel are in the raised position.

* Auxiliary electro/hydraulic power pack with manual hydraulic pump back-up enables cradle to be lowered, safety bars and gate to be opened and tractor disengaged from the aircraft in the event of a power failure.

* In the event of an electrical failure, neutral selected.

* Neutral start switch – engine can only be started with transmission in neutral.

* Interlocked gate prevents unintentional opening when cradle in raised position.

* Cradle cannot be lifted with locking gate and/or safety bars open.

* Locking gate can only be opened when the cradle is in the lowered position.

* With the locking gate closed, the tractor can only be driven with the cradle in the raised position.

* In-cab warning to indicate incorrect nose wheel size selected.

* In-cab indicator to show when the nose wheel is in position.

* Warning/indication of aircraft nose wheel oversteer situation with in-cab and external visual warning lights and audible alarm in cab.

* In-cab warning light and inhibit, to prompt the operator to check that the aircraft nose landing gear steering lock-out pin has been inserted

* Operation of the Douglas-Kalmar range of towbarless tractors does not require assistance from, or interrupt, the pre-checks of the flight deck crew.

* Battery isolation switch.

* Emergency / panic engine shutdown buttons strategically positioned on the tractor. Total 6 nos. one in the cab, two on each side of the tractor and one adjacent to the cradle.

* Park brake is automatically applied when the operators seat is being turned.

* Anti-collision proximity switch sensors are fitted to the cab roof.
On contact with an aircraft the tractor drive is disengaged.

DIAGNOSTIC FACILITY: A modem is fitted to the PLC to enable the tractor to be connected to a suitable telephone line to enable remote trouble shooting from a Douglas Service Centre.

Advanced on-site trouble shooting can also be carried out by connecting to the PLC a standard laptop computer installed with the appropriate software.

GPU: ***Optional:*** A 90 KVA ground power unit can be provided and mounted integrally within the chassis frame.

The GPU can be operated from within the tractor's cab or from the exterior of the tractor.
A stowage tray is provided for the GPU output cable.

COMMUNICATIONS EQUIPMENT:

Optional: VHF - AM and FM air band transceivers with microphones and roof mounted antenna.
[To meet Customer requirements]

FINISH: ***Standard:*** Finish painted in single colour of customer's choice.

Option: In customer's livery.

CAPACITIES:

Cradle lifting capacity: (Aircraft nose wheel weight)	35,000 kgs
Cradle free lift height:	280 mm
Cradle oscillation:	± 8 degrees
Aircraft nose wheel diameter:	550 – 1070 mm
Aircraft nose gear maximum width:	1200 mm

PERFORMANCE

Maximum Tractive Effort: -

Large aircraft	150 kN – 170 kN
Medium aircraft	65 kN – 74 kN
Small aircraft	30 kN

Maximum speeds at 2% rolling resistance: -

Unladen (Solo):		35 kph
Pushback:	280 tonne aircraft	8 kph
	180 tonne aircraft	10 kph
	60 tonne aircraft	26 kph

Maximum speeds at 1% rolling resistance: -

Towing:	140 tonne aircraft	24 kph
	90 tonne aircraft	30 kph
	30 tonne aircraft	32 kph

NOTE: Pushback and Towing speeds are quoted for flat and level ground conditions and are subject to actual rolling resistances, and ground surface conditions.
Aircraft engine idle thrust is not allowed for.

GENERAL ARRANGEMENT DRAWING: TSD 948 Issue 2

PERFORMANCE GRAPH NUMBER: 322

OPTIONAL EXTRAS:

- Integral hydraulic powered jacking system.
- Heated front and rear screens.
- In-cab air conditioning
- High output Eberspacher water boiler type diesel combustion heater/demister.
- Exhaust purifier.
- Fire extinguishers
- Electrically heated and adjustable rear view mirrors.
- Additional camera for CCTV – 3 camera system. Positioned at the rear of the tractor for one man operation.
- Light guards.
- 'Hot wire system' for cold climate operation
- Fuel filter heater.
- Hella aircraft towing strobe light system with associated beacons and warning lights.
- Cab roof window wiper and washer.
- Cab roof ventilator.
- Forward facing spotlights (2 nos) mounted at cab roof level
- GPU and output cable – Alternative outputs available.
- 'Hakorite' hard plastic side mounted rubbing strips.
- Cab roof window blind.
- Communications equipment.

TESTING:

All Douglas Tugmasters are fully tested, and performance proven, before delivery.

QUALITY and SYSTEMS:

Douglas Equipment Limited employ quality management systems which are approved to: -

BS EN ISO 9001:2000

This ensures that all Tugmasters are produced to the highest quality standards using well-proven components.

In line with the Company's policy of continual improvement
DOUGLAS EQUIPMENT reserve the right to amend
this specification without prior notice