



XTRAC 270 CROSS COUNTRY GEARBOX



*THE DESIGN, MANUFACTURE, ASSEMBLY,
TEST & SUPPLY OF
THE '270' TYPE TRANSMISSION*

PREPARED BY: CLIFF HAWKINS
XTRAC LTD
GABLES WAY
KENNET PARK
THATCHAM
BERKSHIRE
ENGLAND
RG19 4ZA

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1.0 INTRODUCTION

This proposal details the technical specification and pricing of a four wheel drive transmission for use in the T3 category of the 2003 Cross Country Rally Championship.

Xtrac is very proud of its association with Cross Country Rallying and our experience goes back to the beginning of the company in 1984.

This transmission represents an opportunity for Xtrac to combine its superior design and manufacturing skills with its experience of lightweight transmissions to fulfill all of the requirements of the 2003 Cross country Rally Championship.

2.0 GEARBOX SPECIFICATION

2.1 Transmission configuration.

The gearbox is in-line, longitudinally mounted.

Drive is taken from the engine crank and passed via a concentrically mounted push operated clutch to the input shaft of the transmission. The clutch, input shaft and clutch release are housed in a simple spacer casing which is designed to be mated to a proprietary Bellhousing. Alternatively a bespoke Bellhousing can be designed and manufactured to suit any installation.

For low RPM high torque applications where the peak input torque is in excess of 800Nm, and the maximum input speed less than 5000rpm, for example a diesel engine, the drive can be taken from the input shaft into an optional single set of torque reducing drop gears. These drop gears would require a bespoke bellhousing to be designed and manufactured to suit the installation.

The drive is then taken into a layshaft and onto a mainshaft which mounts the change gears. All six change gears and reverse gear are dog engaged. The transmission has the facility to accept both sequential and H-pattern gear change mechanisms in the same casings.

A manually actuated differential lock is incorporated into the centre differential as standard; this can be used either as a spool or as an emergency feature, should a prop shaft, differential or driveshaft be damaged.

Drive is then taken via prop shafts, from the centre differential, to both front and rear differential units. Standard torque split, front to rear is 50:50.

Xtrac driveshaft assemblies can be supplied with or without Xtrac's quick release output flange feature.



2.2 Bellhousing and input shaft assembly

The Gearbox is supplied with a simple mounting plate type spacer casing providing attachment for the clutch release mechanism.

Alternatively a bespoke Bellhousing can be designed and manufactured from Aluminium L169 and machined to provide clearance for the chosen clutch and mounting and support to the clutch release assembly, and starter motor assembly if required.

The clutch release assembly is hydraulically actuated and of a proven design.

The input shaft is manufactured from S155 material

For an application with torque reducing drop gears and therefore requiring a bespoke Bellhousing, the size and ratio of the gears will be application specific. Costs and specification can be advised separately upon request.

2.3 Cluster and gear change assembly

The casting material L169 Aluminium is machined to provide clearance for a wide range of change gear ratios plus mounting and support for the layshaft and mainshaft. 'O' ring face sealing is used for all major connecting flange faces.

The cluster and gear change casing will accept six forward gears and reverse. Machining in the casing is configured such that both H-pattern and sequential operation of the gear change can be facilitated by changing a minimum number of parts. However, sequential operation is supplied as standard. All change ratio gears are straight cut with dog engagement (6 dogs).

Reverse, first and second layshaft gears are integral to the layshaft with third to sixth gears as slide on gears. A wide variety of layshaft sets and change gear ratio pairs are available for use in this transmission. Ratio list enclosed. Reverse gear ratio will be 3.333:1. All layshaft gears are retained by a nut and locking device, to maximise stiffness of the assembly and secure the position of these gears in operation.

The Mainshaft assembly is retained by a nut and anti-rotation insert, to maximise stiffness of the assembly and secure the position of all components in operation.

All mainshaft gears are selected by selector forks acting on each dog clutch ring. These forks are cast from steel and house a removable pin to increase component life and reduce operational costs associated with 'one piece' fork designs. A sequential gear change barrel then acts on each fork pin to select each gear in turn.



The sequential gear change barrel is controlled via the well proven Xtrac ratchet mechanism. This would be used to select all forward gears, reverse and the full position neutral. The ratchet mechanism is then actuated by a gear change rack connected via a tube to the in-car gear lever mechanism.

2.4 Power take-off and centre differential assembly

The L169 Aluminium casing is machined to house the centre differential as well as a differential locking mechanism.

Six position options are possible, with the take off position specified +90, +80 and +70 degrees, and at -90, -80 and -70 degrees, measured from the vertical. (i.e. from both left and right hand sides of the transmission)

The centre differential can be specified in three different configurations:

a). Plate or 'Salisbury' type differential (Standard Fitment)

A number of adjustments can be made to this type of differential: Several different plate configurations can be selected to alter the ultimate level of locking achieved across the differential; A choice of different ramp angles (45/85 ramps are fitted to the gearbox) are offered. A ramp angle list is enclosed. These can be selected to vary the level of locking as a proportion of input torque; Finally, several different configurations of Belleville spring and shims can be used to vary the pre-load or minimum locking derived from the differential.

b). Viscous differential (optional)

The ultimate locking value of this type of differential is related to the output speed differential by several factors. Adjustments to the rating of this differential are made on first build at Xtrac and periodically checked and re-set as part of an ongoing maintenance programme.

c). Viscous Combined Plate differential (optional)

This differential is a combination of a). and b). above and offers the advantages of a differential that is both speed sensitive and torque sensitive, when either configuration is needed.

2.5 Front and rear differential assemblies

Xtrac manufacture front and rear differentials, which are compatible with this transmission. These differentials can be supplied separately.



2.6 Lubrication system

A three-stage eccentric rotor pump assembly with 2 dedicated scavenge stages and one pressure stage as follows:

The 2 scavenge stages draw oil from the gearbox at the front of the cluster and at the rear of the gearbox adjacent to the output drop gear assembly via separate filters. The oil from each scavenge stage is deposited into an oil tank, integral into the front transfer case.

The pressure stage draws oil from the internal tank and feeds this to a remote customer supplied oil cooler via a pressure relief valve and back to the main gearbox oil feed point.

Bosses and fixings for temperature and pressure sensors are also provided.

2.7 Ancillary equipment and mounting

An optional ancillary drive can be driven by the layshaft incorporated at the rear of the Gearbox.

This can, for example, facilitate drive to a compressor that could enable a tyre inflator to be driven in all selected gears and also whilst the drive train is in neutral.

Two bosses for speed sensors are provided.

2.8 Materials and Processes

All highly stressed internal components are manufactured from Xtrac's own grades of steel, primarily X36C. Some internal components, particularly constant mesh gears are produced in a vacuum arc remelt steel to Xtrac's own specification - XVAR1. As deemed necessary some gears may also be gear ground for greater accuracy and longer life.

All internal rotating components that are subject to alternating stresses are shot peened. Other materials such as 2014 T6 aluminium are used as deemed necessary especially to save weight. Highly loaded studs are produced from high strength stainless steel. As appropriate some components are drag polished using the Xtrac in house Xtrem process.

Titanium and/or carbon fibre casings, metal matrix materials and ceramic hybrid bearings are not used.



3.0 SERVICING, MAINTENANCE, LIFING AND TRAINING

Xtrac offer a 24 hour parts supply service and a full overhaul facility at our base in Thatcham. We believe that our quality of after sales service should reflect the quality of our components.

Free training will be given for two technicians, at our Thatcham factory, to ensure they can carry out routine maintenance. At this time it would also be possible to finalise the needs for:

- Service tools
- Spare parts and stock levels
- Supply of gearbox layout, parts listings and manual

Xtrac can offer a full service operation from our Thatcham factory.

Xtrac would strongly recommend that customers keep a full lifing record system for all principle components of the transmission in order to monitor service intervals.

Ease of servicing has been a major criteria with the design of the gearbox so customers can carry out some of their own routine work; however we can also offer a number of fixed price packages at a reduced cost. For example:

Full Rebuild (pre-Paris Dakar)

This would include the fitment of the following new parts:

Ratios (1st to 6th), dog rings, drop gears, clutch shaft, Layshaft, Mainshaft, transfer shaft x2, output flanges front and rear, selector fork pins, diff ramps, side gears and pinion mates and friction discs, seals, bearings, oil filter, clutch release assembly.

Inspection and/or crack check of pump bodies, shaft and rotors, selector forks, barrel, selection mechanism etc.

Visco diff re-build and re-set.

Dyno test.

Total cost: £ 8,000 - £ 9,000



Part Rebuild (pre-Season excluding Paris Dakar)

This is a less demanding check for some of the shorter events and would include the fitment of the following new parts, seals, bearings, oil filter.

Crack check and inspection of ratios (1st to 6th), dog rings, drop gears, clutch shaft, output shafts front and rear, transfer shaft x 2, selector fork pins, diff ramps, side gears and pinion mates and friction discs, pump bodys and rotors, selector forks, barrel, selection mech.

Visco diff re-build and re-set

Total Cost: £ 3,000

Tooling

Basic Kit (inc Mainshaft holding tool)	£ 2,800 approx
Full factory kit would include setting jig and barrel socket	£ 3,700 approx

4.0 OPTIONS & EXCLUSIONS

The following options are available for this gearbox; selection of the option needs to be made at the time of ordering.

4.1 Clutch, clutch release and input shaft – options are as follows:

- a) Customer supplied AP push clutch (or similar) housed in bell housing with AP hydraulic clutch release no torque sensing. (Long input shaft from clutch hub or output drop gear to rear of Layshaft)
- b) Customer supplied AP push clutch (or similar) housed in Bellhousing with Xtrac concentric clutch release no torque sensing. (Long input shaft from clutch hub or output drop gear to rear of Layshaft).
- c) Customer supplied AP push clutch (or similar) housed in Bellhousing with Xtrac concentric clutch release with torque sensing. (Long input shaft from clutch hub or output drop gear to rear of Layshaft)



4.2 Engine configuration determines use of the following:

- a) Single torque reducing input drop gear assembly for peak input torques above 800Nm and/or max engine rpm lower than 5000rpm (resulting front mounting flange face to match proprietary Bellhousing). Separate, long input shaft required to link output drop gear to rear of Layshaft or rear mounted clutch).
- b) No drop gear assembly (resulting front mounting flange face to match proprietary Bellhousing).

Note: Option 4.2a will require additional work from Xtrac, see exclusions.

4.3 Gear change cluster configuration:

- a) 5 speed cluster, sequential gear change operation
- b) 5 speed cluster, H-pattern gear change operation *
- c) 6 speed cluster, sequential gear change operation (standard configuration)
- d) 6 speed cluster, H-pattern configuration *

4.4 Output drop gears as follows:

- a) 2 Drop gear ratios, selected remotely by mechanical means (can be run only with 5-speed cluster configurations due to current regulations)(Available late 2002)
- b) 1 Drop gear ratio (can be run with either 5 or 6 speed cluster configurations)(standard configuration)

4.5 Centre differential options as follows:

- a) Plate differential (standard configuration)
- b) Viscous (VCU) differential *
- c) Viscous Combination Plate (VCP) differential *

4.6 Power take off(centre differential) position

Six position options, see text.

4.7 Prop shaft flanges to suit customer requirements.

4.8 Auxiliary drive unit options:

- a) Fitment of direct drive from the Layshaft to an auxiliary drive pulley.
- b) No auxiliary drive with cover plate on rear transfer case (standard configuration)



5.0 EXCLUSIONS

The following are excluding, although Xtrac are able to quote for the majority of the items listed:

- Design and supply of Bellhousing
- Design and supply of Bellhousing including drop gears and additional components
- Supply of alternative clutch release mechanisms to those mentioned Clutch, flywheel, ring gear, starter motor and pinion, starter motor installation design, alternator drive, hydraulic pump or air compressor.
- Supply of oil cooler or heat exchanger, separate oil system pipe work, remote filters and oil system fittings.
- Supply of propshaft, propshaft joints, propshaft boots, Circlips and fasteners.
- Supply of in car gearchange lever and mechanism (sequential of 'H' pattern).
- Supply of pneumatic/vacuum centre diff lock
- Speedometer drive
- Supply of assembly tooling, although design of this is included.
- Modifications to the engine crankshaft and/or engine block if required
- Any special coatings and surface finishing processes not already defined
- The supply of all sensors, including gearchange potentiometer
- Gearbox mock ups and homologation work

6.0 PRICING

6.1 Design and Tooling/Engineering Costs

The design and tooling costs for the gearbox have all been paid by Xtrac. Customers will only need to contribute towards the engineering costs for any special work associated with a customers installation or non standard extras. This would include any gearbox mock ups.



6.2 Gearbox Prices

All gearboxes are supplied fully assembled and rig tested. Gearbox quantities are based on gearboxes ordered at the same time to the same specification and manufactured together.

Production gearboxes	10 + off	£TBA	Each
	6-9 off	£TBA	Each
	4-5 off	£TBA	Each
	2-3 off	£TBA	Each

7.0 DELIVERY

This varies according to the chosen specification, existing stock levels, quantity required and time of year. Typically, deliveries are between 8-16 weeks for the initial gearboxes.

8.0 GENERAL NOTES

- 1 All prices stated are ex-works and can be considered firm for orders placed prior to 1st December 2003. All prices are subject to VAT where applicable.
- 2 All additional work in connection with a customers project is charged, plus expenses for any work away from Xtrac.
- 3 Any bespoke customer parts will be subject to a maximum batch size of two off prototypes. Additional prototypes will be manufactured at customers risk.
- 4 If any delay occurs in the project as a result of delays in the provision of information and parts or as a result of inadequate quality of information, the parties would discuss and agree any required changes to the scope of the work.
- 5 The customer would be responsible for ensuring suitability and adequacy of the gearbox in respect of all engine and suspension loadings.
- 6 Xtrac's Standard Conditions of Sale apply.
- 7 Customers undertake that there will be no recruitment of Xtrac's employee's whilst the two companies are working together.



APPENDIX 1

Ramp Angle List

<u>Part Number (Side Gear Ring)</u>	<u>Angles (Power/Over-run)</u>	<u>Part Number (Cross Pin)</u>
199-290-009A	30/60	154-427-002B
199-290-009H	45/50	154-427-002AF
199-290-009B *	45/85	154-427-002A
199-290-009G	50/60	154-427-002D
199-290-009N	60/60	154-427-002N
199-290-009T	60/75	154-427-002V
199-290-009K	60/85	154-427-002W
199-290-009L	75/85	154-427-002Y
199-290-009D	85/85	154-427-002C

* Fitted to all new gearbox builds

Other ramp angles are available from stock or special order

TERMS & CONDITIONS OF SALE



1. GENERAL

These terms shall be incorporated into all contracts for the sale of goods by Xtrac to the Customer to the exclusion of any terms stipulated by the Customer. No modification or waiver of these terms shall be binding on Xtrac unless confirmed in writing by Xtrac.

2. DELIVERY

Delivery dates quoted are estimates only and are not binding. Xtrac shall have no liability to the Customer or any third party for any financial or other loss or damage (whether direct or indirect) if delivery is delayed, nor shall any such delay entitle the Customer to refuse to accept any goods or to refuse to pay in full for goods when they are delivered.

Prices quoted are ex-works and exclude freight, insurance and delivery charges, Value Added Tax and other taxes or duties, all of which will be invoiced to the Customer as applicable.

Goods are delivered and risk passes to the Customer when Xtrac makes them available to the Customer or any agent of the Customer or any carrier (who shall be the Customer's agent whoever pays his charges) at Xtrac's premises or other delivery point agreed by Xtrac.

Xtrac does not accept any responsibility for damage, shortage or loss in transit, Xtrac will take reasonable steps to assist the Customer's claim against the carrier for any damage, shortage or loss in transit.

3. QUANTITIES

Orders are accepted on the condition that Xtrac may at its option supply 10% more or less than the quantity ordered.

4. ALTERATION OF PRICES

Xtrac reserves the right to increase the price of the goods to reflect any increase in costs to Xtrac which is due to any factor beyond Xtrac's reasonable control such as (without limitation) any foreign exchange fluctuations; currency regulations; alteration of taxes or duties; increases in the cost of labour, material or other costs of manufacture or delivery; any change in delivery dates, quantities or specifications for the goods which is requested by the Customer; or any delay caused by any instructions of the Customer or failure of the Customer to give Xtrac adequate information or instructions.

5. PAYMENT

Goods will be invoiced when ready for despatch and all invoices are payable in pounds sterling (unless other arrangements have been made). In no circumstances is the Customer entitled to make any deduction or withhold payment.

Where Xtrac has agreed to grant credit to the Customer, payment must be made no later than the thirtieth day of the month following that in which the goods are invoiced. Credit terms may be withdrawn or altered by Xtrac at any time with or without notice.

Without prejudice to any other rights or remedies of Xtrac, if the Customer fails to settle any invoice by the due date interest shall be payable on any overdue amount from the date on which payment was due to that on which it is made (whether before or after judgement) on a daily basis at the rate of 3% per annum above the base lending rate for the time being of Barclays Bank plc. The Customer shall in addition reimburse Xtrac all costs and expenses (including legal costs) incurred in the collection of any overdue amount.

If by reason of failure to pay, late payment or otherwise Xtrac considers that the Customer's creditworthiness is impaired, then without prejudice to any other available remedy Xtrac shall be entitled to suspend further deliveries of goods or to suspend performance of its obligations under any contract with the Customer or treat such contract as repudiated.

6. SUB-CONTRACTING OF WORK

Xtrac reserves the right to sub-contract the whole or part of any work at its absolute discretion.

7. TOOLING

All tooling, fixtures and cutters are invoiced at part cost only and are to remain the property of Xtrac.

8. INFRINGEMENT OF THIRD PARTY RIGHTS

The Customer shall indemnify Xtrac against all damages, penalties, cost and expenses to which Xtrac may become liable as a result of work done in accordance with the Customer's specification or requirements which results in infringement or alleged infringement of a patent, registered design or other intellectual property rights of any third party.

9. CONFIDENTIALITY

All information, technical or otherwise, given by Xtrac to the Customer shall be treated as confidential by the Customer and shall not be disclosed to any third party except with the written permission of Xtrac.

10. OWNERSHIP OF GOODS

Notwithstanding the earlier passing of risk, title in the goods shall remain with Xtrac and shall not pass to the Customer until the Customer has paid for them in full. Until title passes the Customer shall hold the goods as the fiduciary agent and bailee of Xtrac and the Customer shall store or make the goods so that at all times they are identifiable as the property of Xtrac. Xtrac shall be entitled at any time before title passes to require the Customer to deliver up the goods to Xtrac and to enter upon any premises of the customer or any third party to repossess the goods. If the Customer re-sells the goods the entire proceeds of such resale or any claim for such proceeds shall be held on trust for Xtrac without prejudice to any other claim which Xtrac may have against the Customer in respect of the goods.

11. WARRANTY AND EXTENT OF LIABILITY

Xtrac shall have no liability to the Customer (other than liability for death or personal injury resulting from Xtrac's negligence) for any loss or damage of any nature arising from any breach of any expressed or implied warranty, term or condition of the contract or from any negligence or breach of statutory or other duty on the part of Xtrac in connection with the performance or purported performance of or failure to perform the contract other than as set out in this Condition. In no circumstances shall Xtrac be liable for any claims for indirect or consequential injury or damage (including loss of profits) arising from any such matters.

Subject to the provision of Condition 2 which apply in the case of loss or damage in transit, if the Customer establishes that any goods have not been delivered or have been delivered damaged, or are not of the correct quantity, or do not comply with their description, Xtrac shall at its option either (i) replace with similar goods any goods which are so missing or damaged or do not comply with their description or (ii) allow a credit to the Customer for their invoice value or (iii) repair any damaged goods.

In the case of goods not manufactured by Xtrac, Xtrac's sole liability shall be to pass on to the Customer the benefit of any guarantees, conditions or warranties received by Xtrac in respect of such goods.

Subject to the preceding paragraph, if the Customer establishes that any goods are defective and notifies Xtrac to this effect and returns the goods in question carriage paid to Xtrac within a period of six months from the date of delivery Xtrac shall at its option (i) replace with similar goods or repair any defective goods or (ii) allow the Customer credit for their invoice value.

No claim shall arise against Xtrac for any defect arising from any design or specification provided by the Customer or if any adjustments, alterations or other work has been done to the goods by any person other than Xtrac.

In no circumstances shall the liability of Xtrac to the Customer exceed the invoice value of the goods.

12. RETURN OF GOODS

Goods made to special order cannot be accepted back for credit unless incorrect or defective. In other cases where it may be agreed to accept the return of goods for credit, a handling charge may be made at Xtrac's discretion. Such goods must be in resaleable condition and returned carriage paid. No credit will be allowed for goods supplied more than six months previously.

13. LAW

The applicable law shall be the law of England.