Technify Motors GmbH
Platanenstraße 14
D - 09356 St. Egidien

Tel. +49 37204 696-0
Fax +49 37204 696-1910
www.continentaldiesel.de
support@continentaldiesel.de

Installation Manual

CD-135 / CD-155

Doc. No.: IM-02-02
Version: 4/2

■ CAUTION:
This installation manual must be read completely before installing the engine, as it contains important information concerning safety for assembly, safety and operation.

◆ Note:
The Installation Manual must be included at the time of sale of the engine / aircraft.

◆ Note:
Please report any service difficulties to the Technical Support Center at Technify Motors GmbH. See above for contact information.

P/N: 05-7200-H210016

This page intentionally left blank

Table of contents

This page intentionally left blank

List of Figures

0.1 List of Revisions

Document No.	Issue/Rev.	Remark	Date	Approved by
Issue 1 / Revision 1:				
02-IM-00-02	1/1		15.11.2006	Hartung
02-IM-08-02	1/1		15.11.2006	Hartung
02-IM-10-02	1/1		15.11.2006	Hartung
02-IM-11-02	1/1		15.11.2006	Hartung
02-IM-12-02	1/1		15.11.2006	Hartung
Issue 1 / Revision 2:				
02-IM-00-02	1/2		27.02.2007	Hartung
02-IM-03-02	1/1		27.02.2007	Hartung
02-IM-04-02	1/1		27.02.2007	Hartung
02-IM-00-02	1/2		27.02.2007	Hartung
02-IM-03-02	1/1		27.02.2007	Hartung
02-IM-04-02	1/1		27.02.2007	Hartung
Issue 1 / Revision 3:				
02-IM-00-02	1/3		29.06.2007	Hartung
02-IM-04-02	1/2		29.06.2007	Hartung
02-IM-05-02	1/1		29.06.2007	Hartung
02-IM-08-02	1/2		29.06.2007	Hartung
02-IM-10-02	1/2		29.06.2007	Hartung
02-IM-11-02	1/2		29.06.2007	Hartung
02-IM-12-02	1/2		29.06.2007	Hartung
02-IM-13-02	1/1		29.06.2007	Hartung
02-IM-14-02	1/1		29.06.2007	Hartung
02-IM-15-02	1/1		29.06.2007	Hartung
Issue 1 / Revision 4:				
02-IM-00-02	1/4		12.10.2009	Hartung
02-IM-01-02	1/1		12.10.2009	Hartung

Document No.	Issue/Rev.	Remark	Date	Approved by
02-IM-02-02	1/1		12.10.2009	Hartung
02-IM-03-02	1/2		12.10.2009	Hartung
02-IM-04-02	1/3		12.10.2009	Hartung
02-IM-05-02	1/2		12.10.2009	Hartung
02-IM-06-02	1/1		12.10.2009	Hartung
02-IM-08-02	1/3		12.10.2009	Hartung
02-IM-10-02	1/3		12.10.2009	Hartung
02-IM-11-02	1/3		12.10.2009	Hartung
02-IM-13-02	1/2		12.10.2009	Hartung
Issue 2 / Revision 0:				
02-IM-00-02	2/0		17.08.2012	Hartung
02-IM-01-02	2/0		17.08.2012	Hartung
02-IM-03-02	2/0		17.08.2012	Hartung
02-IM-04-02	2/0		17.08.2012	Hartung
02-IM-05-02	2/0		17.08.2012	Hartung
02-IM-06-02	2/0		17.08.2012	Hartung
02-IM-07-02	2/0		17.08.2012	Hartung
02-IM-08-02	2/0		17.08.2012	Hartung
02-IM-09-02	2/0		17.08.2012	Hartung
02-IM-10-02	2/0		17.08.2012	Hartung
02-IM-11-02	2/0		17.08.2012	Hartung
02-IM-12-02	2/0		17.08.2012	Hartung
02-IM-13-02	2/0		17.08.2012	Hartung
02-IM-14-02	2/0		17.08.2012	Hartung
02-IM-15-02	2/0		17.08.2012	Hartung

Document No.	Issue/Rev.	Remark	Date	Approved by
Issue 3 / Revision 0:				
02-IM-00-02	3/0	Editorial Changes, Update	28.01.2014	Hartung
02-IM-01-02	3/0	Editorial Changes, Figure Update	28.01.2014	Hartung
02-IM-03-02	3/0	Editorial Changes	28.01.2014	Hartung
02-IM-04-02	3/0	Editorial Changes, Update	28.01.2014	Hartung
02-IM-05-02	3/0	Editorial Changes	28.01.2014	Hartung
02-IM-06-02	3/0	Editorial Changes	28.01.2014	Hartung
02-IM-07-02	3/0	Editorial Changes, Description Update, Figure Update	28.01.2014	Hartung
02-IM-08-02	3/0	Editorial Changes	28.01.2014	Hartung
02-IM-09-02	3/0	Editorial Changes	28.01.2014	Hartung
02-IM-10-02	3/0	Editorial Changes, Description Update, Figure Update	28.01.2014	Hartung
02-IM-11-02	3/0	Editorial Changes	28.01.2014	Hartung
02-IM-12-02	3/0	Editorial Changes, Description Update, Figure Update	28.01.2014	Hartung
02-IM-13-02	3/0	Editorial Changes	28.01.2014	Hartung
02-IM-14-02	3/0	Editorial Changes, Description Update, Figure Update	28.01.2014	Hartung
02-IM-15-02	3/0	Editorial Changes	28.01.2014	Hartung
Issue 3 / Revision 1:				
02-IM-00-02	3/1	Update	22.05.2014	Hartung
02-IM-08-02	3/1	Note added	22.05.2014	Hartung
02-IM-12-02	3/1	Description Update	22.05.2014	Hartung
02-IM-14-02	3/1	Description Update	22.05.2014	Hartung

Document No.	Issue/Rev.	Remark	Date	Approved by
Issue 4 / Revision 0:				
all	4/0	Engine Name changed from Centurion in Continental Diesel, C 2.0 to CD-135 and C 2.0S to CD-155 Figure Update	30.07.2014	Hartung
Issue 4 / Revision 1:				
02-IM-00-02	4/1	Update	28.11.2014	Hartung
02-IM-04-02	4/1	Fuel additive added	28.11.2014	Hartung
02-IM-05-02	4/1	Note update	28.11.2014	Hartung
02-IM-08-02	4/1	Figure deleted	28.11.2014	Hartung
02-IM-13-02	4/1	FADEC D48 / D4 Update, Start phase monitoring added	28.11.2014	Hartung
02-IM-14-02	4/1	Propeller requirements added	28.11.2014	Hartung
Issue 4 / Revision 2				
02-IM-14-02	4/2	Update max. propeller weight Update csu pressure	30.01.2015	Hartung

0.2 List of applicable chapters

Document No.	Document	Issue	Revision	Date
02-IM-00-02	Lists	4	2	30.01.2015
02-IM-01-02	Introduction	4	-	30.07.2014
02-IM-02-02	Safety	4	-	30.07.2014
02-IM-03-02	Engine Description	4	-	30.07.2014
02-IM-04-02	Technical Data	4	1	28.11.2014
02-IM-05-02	Transport and Packaging	4	1	28.11.2014
02-IM-06-02	Engine Mounting and Installation Position	4	-	30.07.2014
02-IM-07-02	Exhaust System	4	-	30.07.2014
02-IM-08-02	Cooling System	4	1	28.11.2014
02-IM-09-02	Cooling Air Duct System	4	-	30.07.2014
02-IM-10-02	Lubricating System	4	-	30.07.2014
02-IM-11-02	Fuel System	4	-	30.07.2014
02-IM-12-02	Intake System	4	-	30.07.2014
02-IM-13-02	Electrical System and FADEC Installation	4	1	28.11.2014
02-IM-14-02	Propeller Drive	4	2	30.01.2015
02-IM-15-02	Vacuum Pump	4	-	30.07.2014

Prepared:	Checked:	Approved:
D. Dick	C. Rudolph, MPI	D. Hartung, MPL

The technical information contained in this document has been approved under the authority of EASA Design Organisation Approval No. EASA.21J.010.

Technify Motors GmbH
Geschäftsführer: Kenneth Robert Suda, Shan Tian
Amtsgericht Chemnitz HRB 28249 - USt. Ident.-Nr. DE 287721150

0.3 Preliminary Remarks

1. The chapter numbering of the footer is different to the chapter numbering of the remaining manual. See Fig. 0.1.

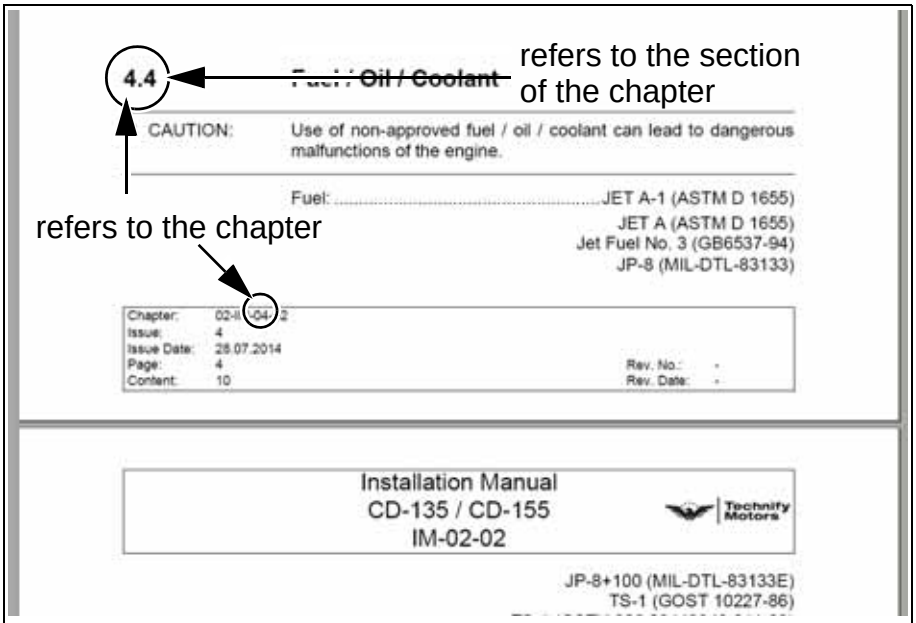

Fig. 0.1 Explanation of the chapter numbering system

1 Introduction

1.1 General Information

This manual contains installation instructions to correctly install your engine.
Although these instructions are correct at the time of publication, Service Bulletins, Service Letters, and Manual amendments at the discretion of the aircraft OEM will be used to issue changes.
Please contact Technify Motors GmbH at the following addresses regarding any clarification that is required on installation of the engine or its components. We would be glad to help you.

Contact address:
Technify Motors GmbH
Platanenstrasse 14
09356 St. Egidien - GERMANY
Fon: +49 37204 696-0
Fax: +49 37204 696-2912

◆ Note: Please also read the aircraft manufacturer's manual.

1.2 Abbreviations

The following abbreviations are used in this installation manual:

AWL	Alternator Warning Light
CAN	Controller Area Network
CED	Compact Engine Display
Dc	Deflection Component
EMC	Electromagnetic Compatibility
FADEC	Full Authority Digital Engine Control
FAR	Federal Aviation Regulations
JAR	Joint Aviation Requirements
LLK	Intercooler
MAP	Manifold Air Pressure
MSL	Mean Sea Level
Pfuel	Fuel Pressure
Tfuel	Fuel Temperature

1.3 Engine Identification

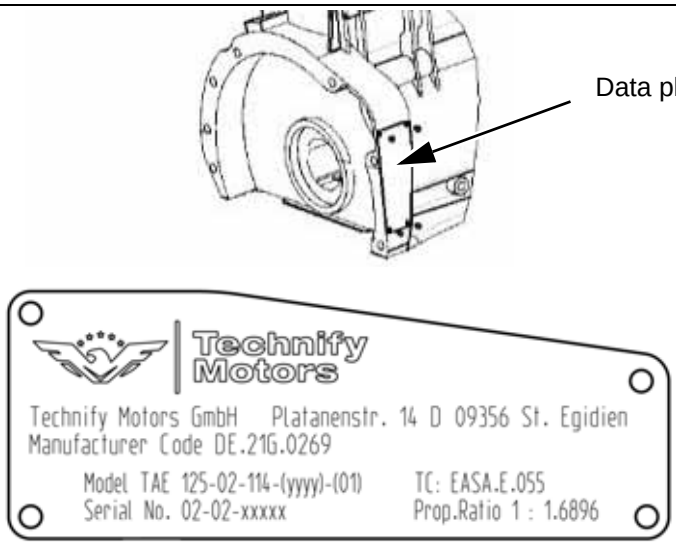

Fig. 1.1 Engine identification

◆ Note: The serial number of the engine must be quoted in the event of any inquiries.

◆ Note: Further information about the key for serial numbers of the engine is published in Service Bulletin **TM TAE 000-0005**.

1.4 Copyright ©

1.5 Engine Variants and approved Installations

The engine variants and approved installations are listed in Service Bulletin **TM TAE 000-0007**.

■ CAUTION: The engine must be installed with an approved software mapping according to Service Bulletin **TM TAE 000-0007**.

2 Safety

The relevant provisions of the employer's liability insurance organization and the other relevant safety rules of e.g. the trade supervision authority must be observed.
The work described below shall only be performed by trained persons or specialized companies who hold current and valid licenses from the aviation authority to carry out such work.

2.1 Safety Recommendations

The following symbols and warning signs are used in the manual. They must be heeded strictly to prevent personal injury and material damage, to avoid impairment of the operational safety of the aircraft and to rule out any damage to the aircraft as a consequence of improper handling.

▲ **WARNING:**	Disregarding these safety rules can cause personal injury or even death.
■ CAUTION:	Disregarding these special instructions and safety measures can cause damage to the engine or other components.
◆ Note:	Additional note or instructions for better understanding of an instruction.

2.2 Safety Information

▲ **WARNING:** The engine must only be installed by qualified technicians (authorized by the responsible aviation authority).

▲ **WARNING:** Aircraft Engine Ground Run must be conducted in a secure area that is protected from the unauthorized movement from personnel!

- This engine is not capable for aerobatics use.
- This engine is not approved for rotor craft (helicopters, gyro-copters, etc.).
- Never leave the aircraft unattended while the engine is running.
- Secure all tools before starting the engine to prevent personal injury or damage.
- Protect the engine and the fuel system against contamination and potentially hazardous manipulation when the engine is switched off.
- Never operate the engine without the specified quality and quantity of fluids.
- Engine monitoring instruments are not included in the supply scope of the engine. Only use suitable, approved instruments.

◆ Note: Technify Motors GmbH offers a suitable combined engine display under the order number 02-7730-5501-()-() which can be used to monitor all of the engine parameters. This display is certified in accordance with JTSO-C113 by the Luftfahrt-Bundesamt.

- In some areas, at some flight altitudes and under certain flight conditions, it may be necessary to protect the engine from extreme humidity, dust or sand using further special equipment. Additional maintenance is required under detrimental operating conditions. Please consult the aircraft manufacturer or dealer.
- The CD-135 engine must only be operated by persons who are familiar with the related manuals and who have received the necessary training and the required level of authorization.

- Only equipment approved by Technify Motors GmbH must be used. The use of any unapproved equipment absolves the manufacturer from any liability.
- Improper installation and the use of non-suitable lines for the fuel, cooling and oil circuits as well as operation with non-approved fuels or lubricants / oils absolves the manufacturer from any liability.
- Modifications to the engine are strictly prohibited. Unauthorized changes to the engine or aircraft will cause the license to expire. The manufacturer cannot be held liable for any damage arising from any unauthorized changes.
- The pertinent accident prevention regulations as well as other commonly accepted safety, occupational health and air traffic legal requirements must be observed.
- Operators must also observe any additional regulations and requirements which are applicable in their territory.

2.3 Legal Notice

▲ **WARNING:** The engine and gearbox are sold dry (i.e. without oil), if not declared otherwise.
The engine must be filled with engine oil and the gearbox must be filled with gearbox oil, before taking the engine into operation.
Only use approved oils and lubricants. Refer to Chapter 4.4 of this manual for approved oils and lubricants.

■ CAUTION: Only GENUINE Technify Motors GmbH parts and accessories guarantee compliance with the manufacturer's technical requirements. If GENUINE Technify Motors GmbH parts are not used, Technify Motors GmbH will be discharged from any liability. In case of improper installation liability for resulting damage will be repudiated.

2.4 Accompanying applicable Documents

Manual Title	Doc. No.
Operation & Maintenance Manual	OM-02-02
Repair Manual	RM-02-02
Illustrated Parts Catalogue	IPC-02-02
Aircraft Manufacturer´s Manual	---

◆ Note: The current version of the manuals are announced in the Service Bulletin **TM TAE 000-0004**.

3 Engine Description

3.1 Engine Designation

CD-135 (TAE 125-02-99)
CD-155 (TAE 125-02-114)

3.2 Engine Description

The Continental Diesel CD-135 / CD-155 is a liquid-cooled 4-cylinder in-line four-stroke diesel engine with DOHC (double overhead camshaft). The valves are actuated by a cam follower. The operation of the direct diesel-injection engine is based on the common-rail technique and is turbo charged. The engine is controlled by a FADEC system. The propeller is driven via an integrated gearbox (i=1.69) with a clutch or dual mass flywheel. The engine is equipped with an electric starter and an alternator.

3.3 Scope of Supply

The following components and assemblies are included in the scope of supply of the CD-135 / CD-155:

- Turbocharger
- Integrated propeller controlling and adjusting unit
- Alternator
- Starter
- FADEC System
- Wiring harness
- All of the actuators and sensors required for engine operation
- Oil pump
- Vacuum pump (CD-155 optional)
- Water pump
- Gearbox
- Engine shock mounts
- Injection system
- Fuel feed pump and high-pressure pump
- Oil Heat Exchanger (CD-155 only)
- Gearbox Oil Heat Exchanger

◆ Note: To maintain compliance with the airworthiness requirements for operation of this engine, only components, materials and procedures for workmanship, that have been approved by Technify Motors GmbH are to be used. Deviations from approved components, materials and procedures can be reasonable cause to cancel manufacturer's guarantees and warranties.

3.4 Engine Views

◆ Note: The coordinate system defined in these views forms the basis for all dimension specifications in the installation manual.

◆ Note: The indications "right", "left", "front" and "rear" are always relative to the flight direction. The following symbol is used:

Example of flight direction right: ➡

Front view of CD-135

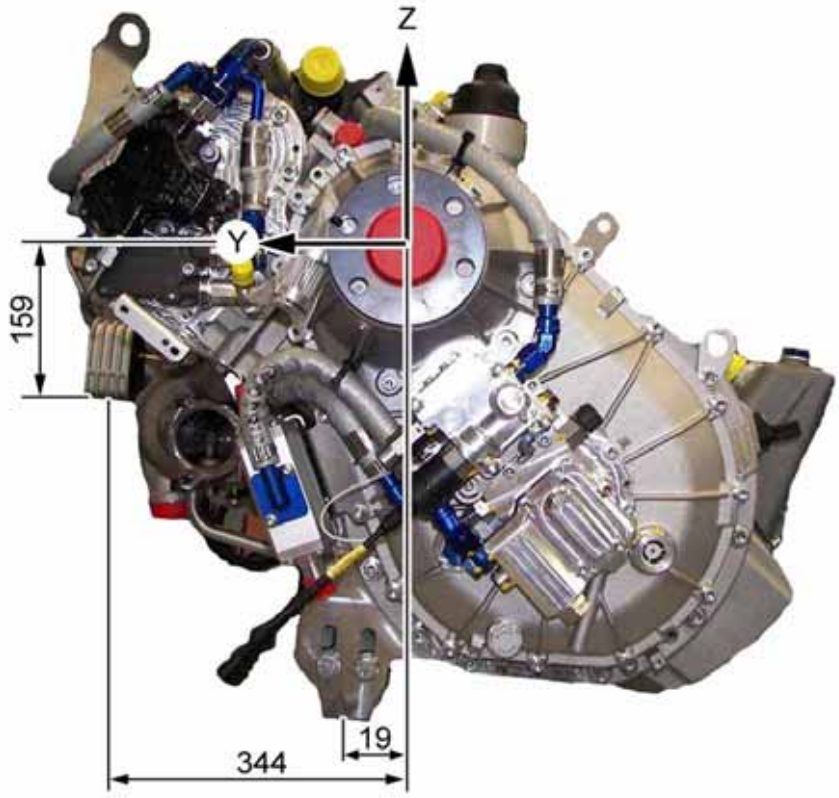

Fig. 3.1 Front view of CD-135 (dimensions in mm)

Top view of CD-135

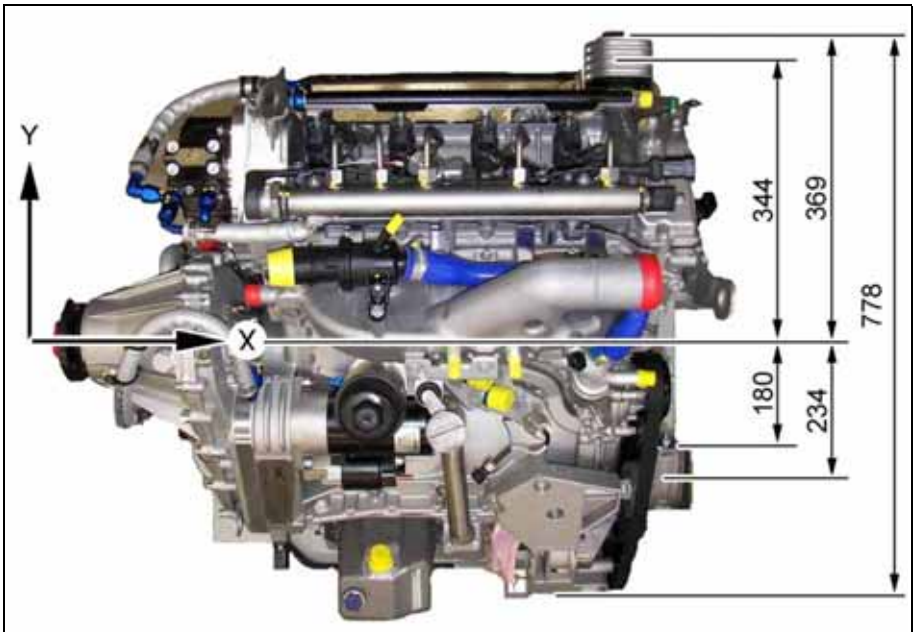

Fig. 3.2 Top view of CD-135 (dimensions in mm)

Side view of CD-135 (flight direction left)

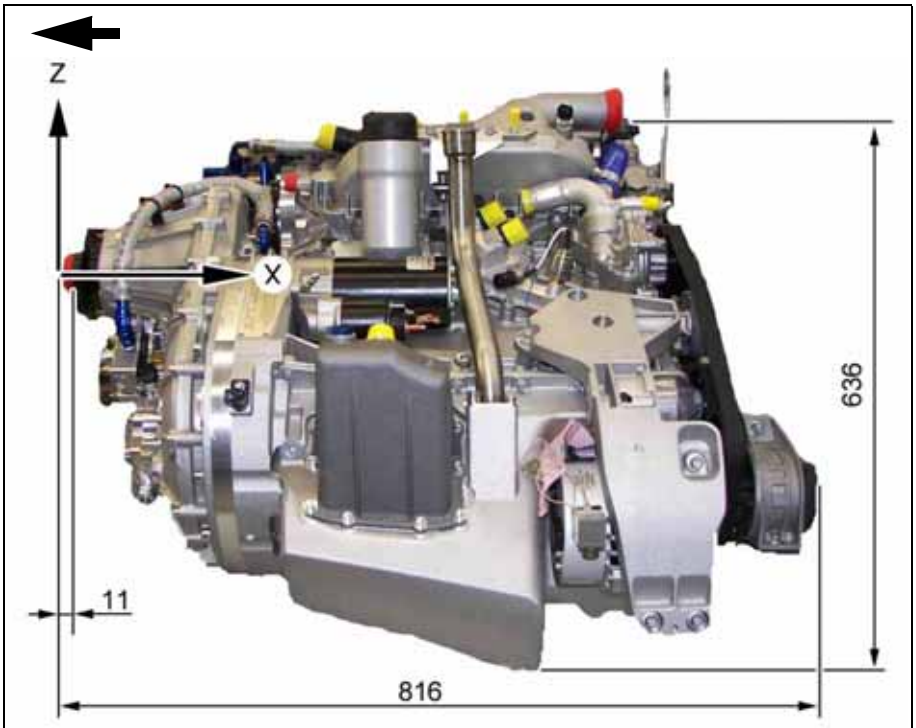

Fig. 3.3 Side view (left) of CD-135 (dimensions in mm)

Side view of CD-135 (flight direction right)

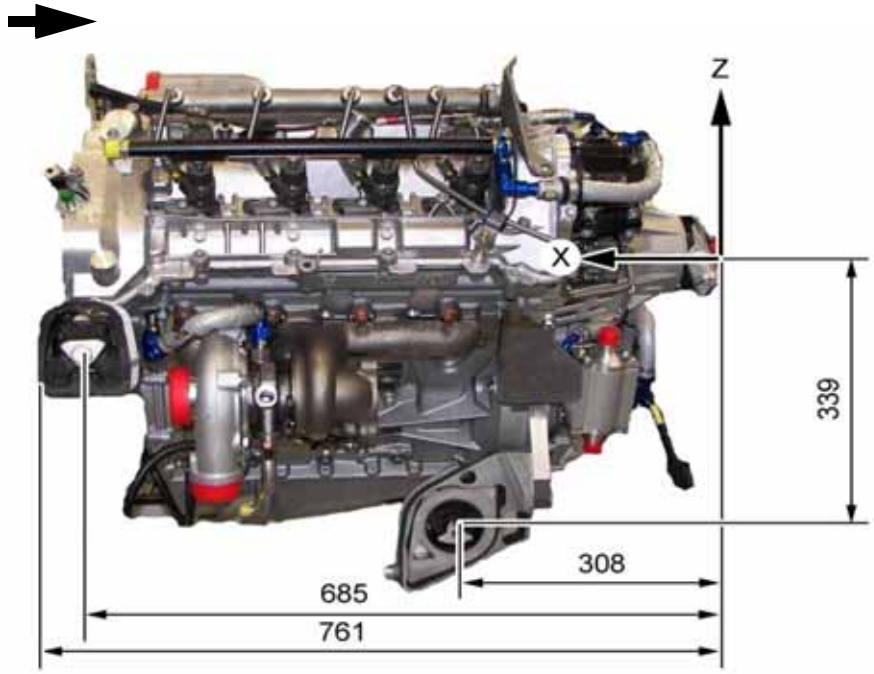

Fig. 3.4 Side view (right) of CD-135 (dimensions in mm)

Front view of CD-155

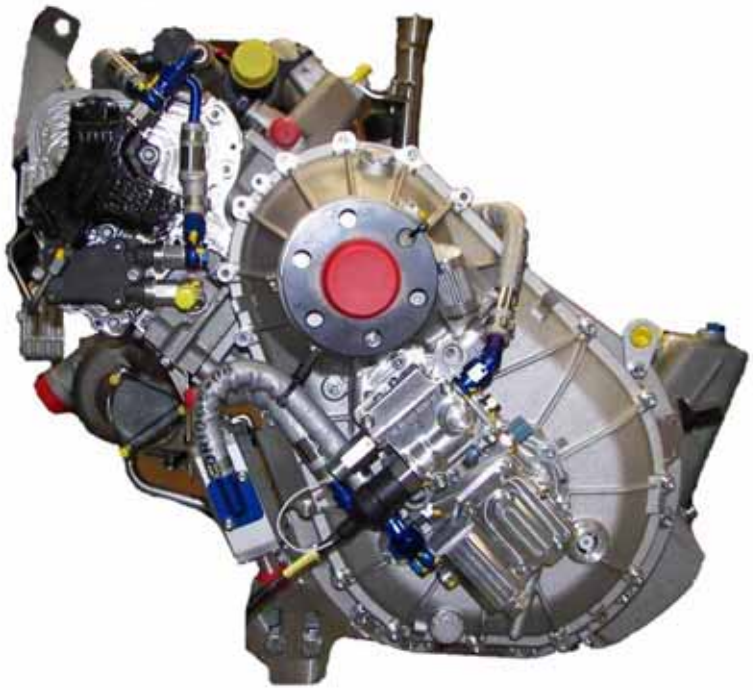

Fig. 3.5 Front view of CD-155 (dimensions as above)

Top view of CD-155

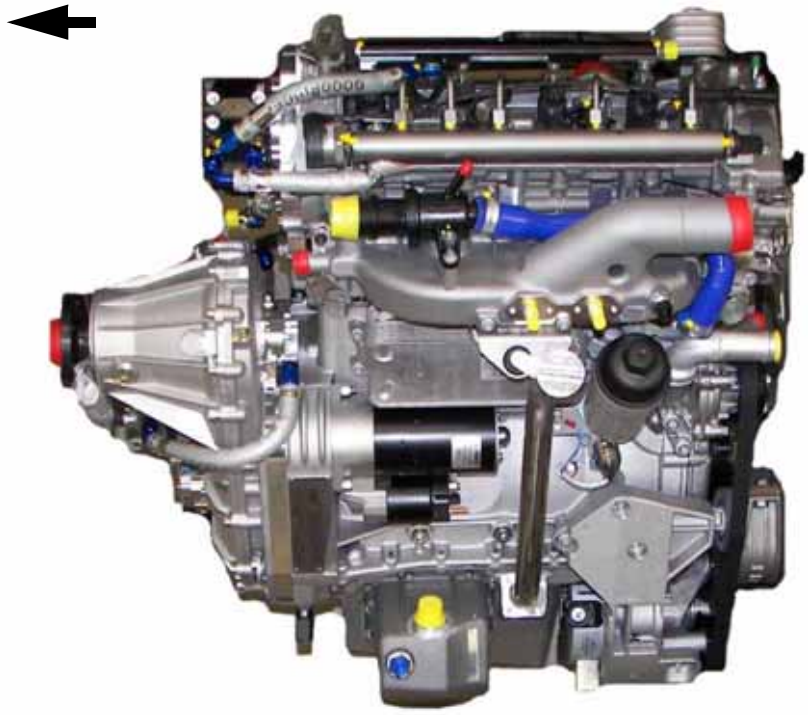

Fig. 3.6 Top view of CD-155 (dimensions as above)

Side view of CD-155 (flight direction left)

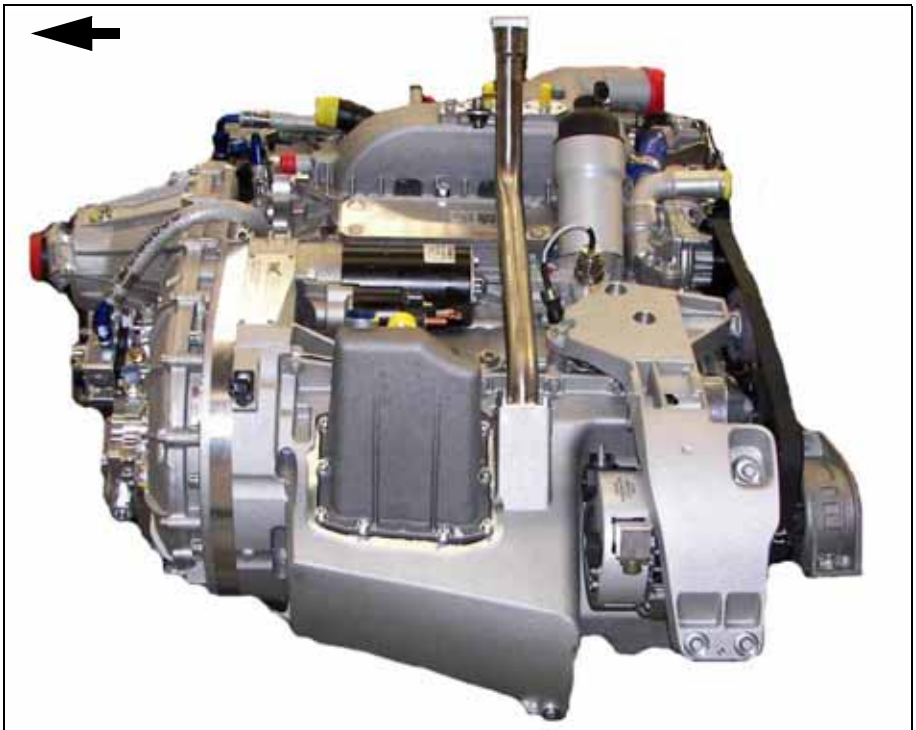

Fig. 3.7 Side view (left) of CD-155 (dimensions as above)

Side view of CD-155 (flight direction right)

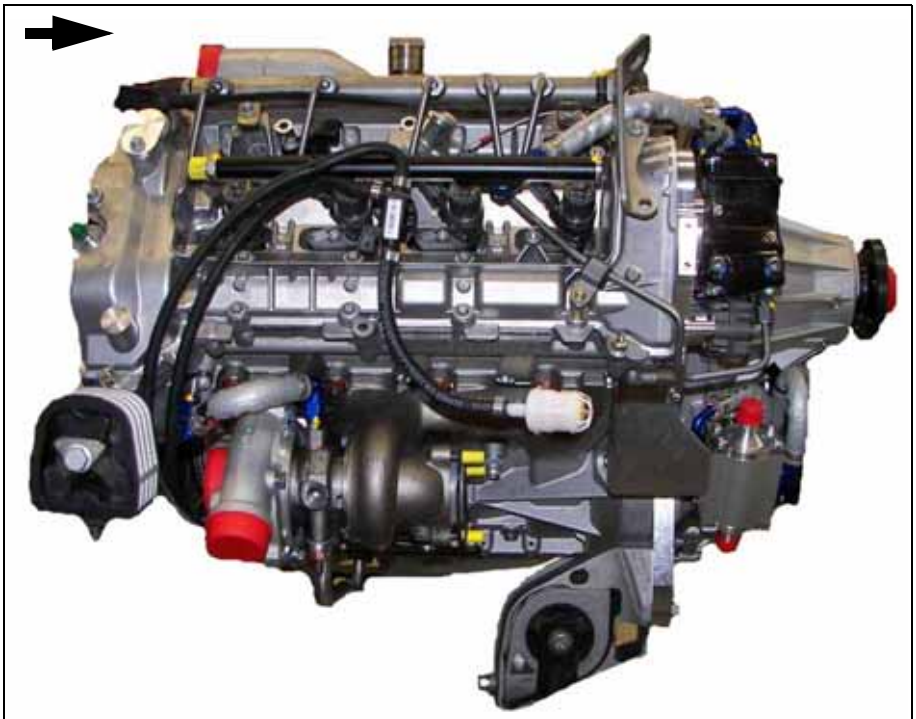

Fig. 3.8 Side view (right) of CD-155 (dimensions as above)

4 Technical Data

4.1 General Information

◆ Note: The operating limits are specified in the Engine Operation and Maintenance Manual OM-02-02.

◆ Note: All speed-related data in the Operation and Maintenance Manual refer to propeller speeds unless explicitly specified as engine speeds.

◆ Note: The performance and operational data refer to sea level at 15°C and 0% relative humidity.

4.2 Dimensions and Weights

Engine dimensions ..... refer to
Chapter 3, Section 3.4, Page 2 of this Manual

Bore ..... 83.00 mm

Stroke ..... 92.00 mm

Cylinder spacing (center to center) ..... 90.00 mm

Displacement total ..... 1991 cm³

Displacement (per cylinder) ..... 498 cm³

Compression ratio 18:1

Firing order 1-3-4-2

◆ Note: The cylinder numbering starts at the firewall.

Weight (dry) ..... 134 kg

Center of gravity ..... refer to
Chapter 6, Section 6.2, Page 1 of this Manual

4.3 Engine and Gearbox Data

4.3.1 Specifications

TAE 125-02-99 (CD-135)

Max. takeoff power (propeller speed)..... 99 kW at 2300 rpm
Max. continuous power (propeller speed) ..... 99 kW at 2300 rpm
Recommended cruise power ..... 71 kW at 2010 rpm
Best Economy ..... 71 kW at 2010 rpm
Idling speed (propeller speed).....890 rpm
Gearbox, propeller drive .....i = 1.69

TAE 125-02-114 (CD-155)

Max. takeoff power (propeller speed)..... 114 kW at 2300 rpm
Max. continuous power (propeller speed) ... 114 kW at 2300 rpm
Recommended cruise power ..... 97 kW at 2010 rpm
Best Economy ..... 71 kW at 1950 rpm
Idling speed (propeller speed).....890 rpm
Gearbox, propeller drive .....i = 1.69

4.3.2 Engine Limitations

Oil pressure:

Normal operating pressure..... 2.3 - 6 bar
min. 1.0 bar / max. 6.5 bar

Oil temperature:

Optimum operating temperature .....approx. 90°C - 110°C
min. 50°C / max. 140°C

Oil consumption:..... max. 0.1 l/h
Oil quantity: .....4.5 - 6 l
plus the volume in the pipes and oil cooler

Coolant temperature:

Optimum operating temperature .....approx. 85°C - 100°C
min. 60°C / max. 105°C

Manifold Air-pressure:

CD-135.....2225 mbar absolute (takeoff)

CD-155.....2350 mbar absolute (takeoff)

Temperature in the manifold after intercooler: ..... max. 80°C
optimum. < 40°C

Exhaust gas temperature: ..... max. 800°C

Ambient temperature for FADEC: ..... max. 70°C

Fuel temperature:

Fuel inlet temperature feed pump: ..... max. 60°C

Fuel pressure:

Intake of feed pump: ..... min. 0.2 bar (absolute)
max. 3 bar (absolute)

Fuel consumption:

CD-135 ..... max. 28 l/h

CD-155 ..... max. 34 l/h

Time limit for engine operation

at the Max. Cont. Power setting in

agravic with negative g-force values: ..... -0.2 g up to 5 s
-0.3 g up to 4 s
-0.4 g up to 3 s
-0.5 g up to 2 s

Engine start up temperature: ..... min. -32°C

Opening-up Temperature (JET A-1 / JET A / Jet Fuel No. 3 / JP-8 / JP-8+100 operation): ..... min. -32°C

Opening-up Temperature (diesel operation): ..... min. -5°C

◆ Note: The opening up temperature (min. -5°C) can be lowered to min. -10°C by using Liqui Moly "Diesel Fliess-Fit" in the appropriate ratio.

Banking (rotations deviating from the apparent perpendicular):

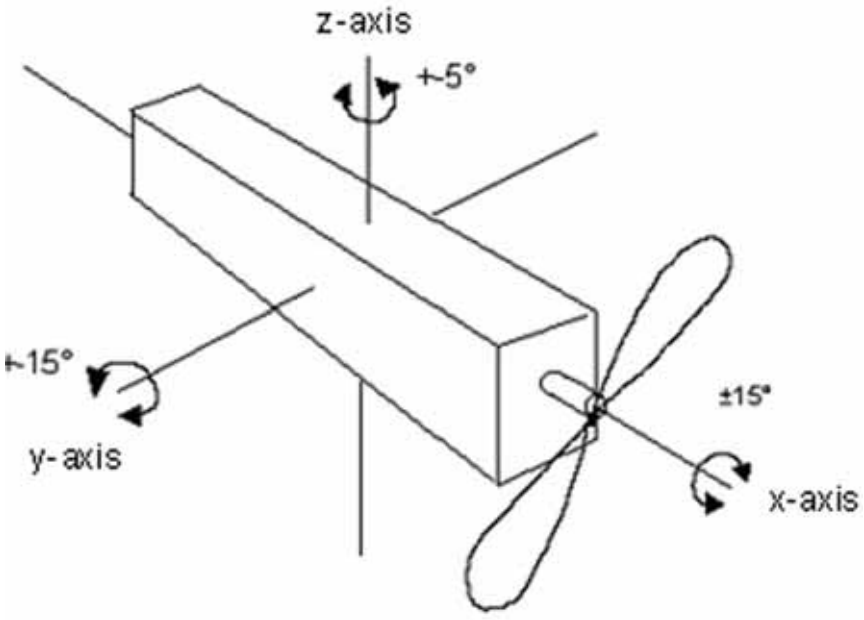

Fig. 4.1 Banking

Around the x-axis ..... max. +/- 15°
Around the y-axis ..... max. +/- 15°
Around the z-axis ..... max. +/- 5°

◆ Note: Up to these deviations from the apparent perpendicular, proper lubrication is ensured.

Gearbox oil filling quantity:..... approx. 1.2 l

4.4 Fuel / Oil / Coolant

■ CAUTION: Use of non-approved fuel / oil / coolant can lead to dangerous malfunctions of the engine.

Fuel: .....JET A-1 (ASTM D 1655)
JET A (ASTM D 1655)
Jet Fuel No. 3 (GB6537-94)
JP-8 (MIL-DTL-83133)
JP-8+100 (MIL-DTL-83133E)
TS-1 (GOST 10227-86)
TS-1 (GSTU 320.00149943.011-99)

Alternative: ..... Diesel (EN 590)
SASOL GTL Diesel

▲ **WARNING:** If operating with diesel, the national appendices to standard EN 590 of the relevant countries as well as the expected temperatures in the intended operating environment must be taken into account.

▲ **WARNING:** The takeoff with Diesel fuel is not permitted, if the temperature of the fuel in the tank is below -5°C (-10°C if Liqui Moly "Diesel Fliess-Fit" is added at appropriate ratio).

▲ **WARNING:** The takeoff with SASOL GTL Diesel fuel is not permitted, if the temperature of the fuel in the tank is below -5°C.

▲ **WARNING:** If you do not know what fuel grade is in the tank, always assume it is additive-free Diesel.

Fuel additive JET A: ..... Prist Hi-Flash Anti-Icing Fuel Additive
(MIL-DTL-85470(B); ASTM D 4171)

▲ **WARNING:** Prist Hi-Flash Anti-Icing Fuel Additive is only allowed in operation with JET A.

■ CAUTION: If operating the engine with Prist Hi-Flash Anti-Icing Fuel Additive, the specifications of the manufacturer must be adhered to.

Fungizids Fuel additive: ..... Fungizids Biobor JF
(MIL-S-53021A)

■ CAUTION: Fungizids Biobor JF Fuel Additive is allowed in operation with Diesel and JET Fuels.
Biobor JF kills hydrocarbon utilizing micro-organisms (or, HUM Bugs) which cause fuel tank contamination.
If operating the engine with Fungizids Biobor JF Fuel Additive, the specifications of the additive manufacturer and the aircraft manufacturer's instructions must be adhered to.

Engine oil: ..... AeroShell Oil Diesel Ultra
AeroShell Oil Diesel 10W-40
Shell Helix Ultra 5W-30
Shell Helix Ultra 5W-40

■ CAUTION: Use the approved oil with exact declaration only!

Gearbox oil: .....CENTURION Gearbox Oil N1
Shell Spirax S6 ATF ZM
Shell Spirax S6 GXME 75W-80, API GL-4
Shell Spirax S4 G 75W-90, API GL-4

■ CAUTION: Use the approved oil with exact declaration only!

Coolant: .....Water / radiator protection mixed at ratio of 50:50

Radiator protection ..... BASF Glysantin Protect Plus / G48
Valvoline / Zerex Glysantin G48
BASF Glysantin Alu Protect / G30
Valvoline / Zerex Glysantin G30
BASF Glysantin Protect / G05
Valvoline / Zerex Glysantin G05
Mobil Antifreeze Extra (G48)
Comma Xstream Green - Concentrate (G48)

▲ **WARNING:** No coolant loss may occur during operation! Any coolant loss must immediately be followed by a technical inspection which has to be carried out by an authorized person. Engine damage could result from coolant loss and this could cause engine failure.

▲ **WARNING:** If the ice flocculation point of the coolant is outside the specified range, the full anti-corrosion and anti-freeze protection is possibly not guaranteed.

■ CAUTION: Glysantin G05, Glysantin G30 and Glysantin G48 must not be mixed with each other.

■ CAUTION: Operation with Glysantin G30 is only permitted without silicate pouch.

■ CAUTION: Operation with Glysantin G05 or Glysantin G48 is only permitted with silicate pouch.

■ CAUTION: Exchange between the coolants Glysantin G30 and Glysantin G05 / Glysantin G48 is not permitted without an alternation of the installation.

■ CAUTION: The exchange to the respectively other approved coolant demands the installation or demounting of the silicate pouch, this depends on the used coolant. Observe the other caution notes of this section.

■ CAUTION: The water must meet the following requirements:

1. Visual appearance: colorless, clear, no deposits allowed
2. pH-value: 6.5 to 8.5
3. Water hardness: max. 2.7 mmol/l
4. Hydrogen carbonate: max. 100 mg/l
5. Chloride concentration: max. 100 mg/l
6. Sulfate concentration: max. 100 mg/l

◆ Note: It is recommended to use Glysantin Protect Plus Ready-Mix and Glysantin Alu Protect Ready-Mix respectively to ensure proper coolant quality.

◆ Note: The ice floccuation point of the coolant is -38°C, if mixed 50:50. Glysantin G48 is an anti-corrosion and anti-freeze additive. The ice flocculation point must be -38°C +/-2°C. If the freezing point is outside this range the coolant has to be exchanged.

4.5 Power Curve

The values refer to 0% relative humidity.

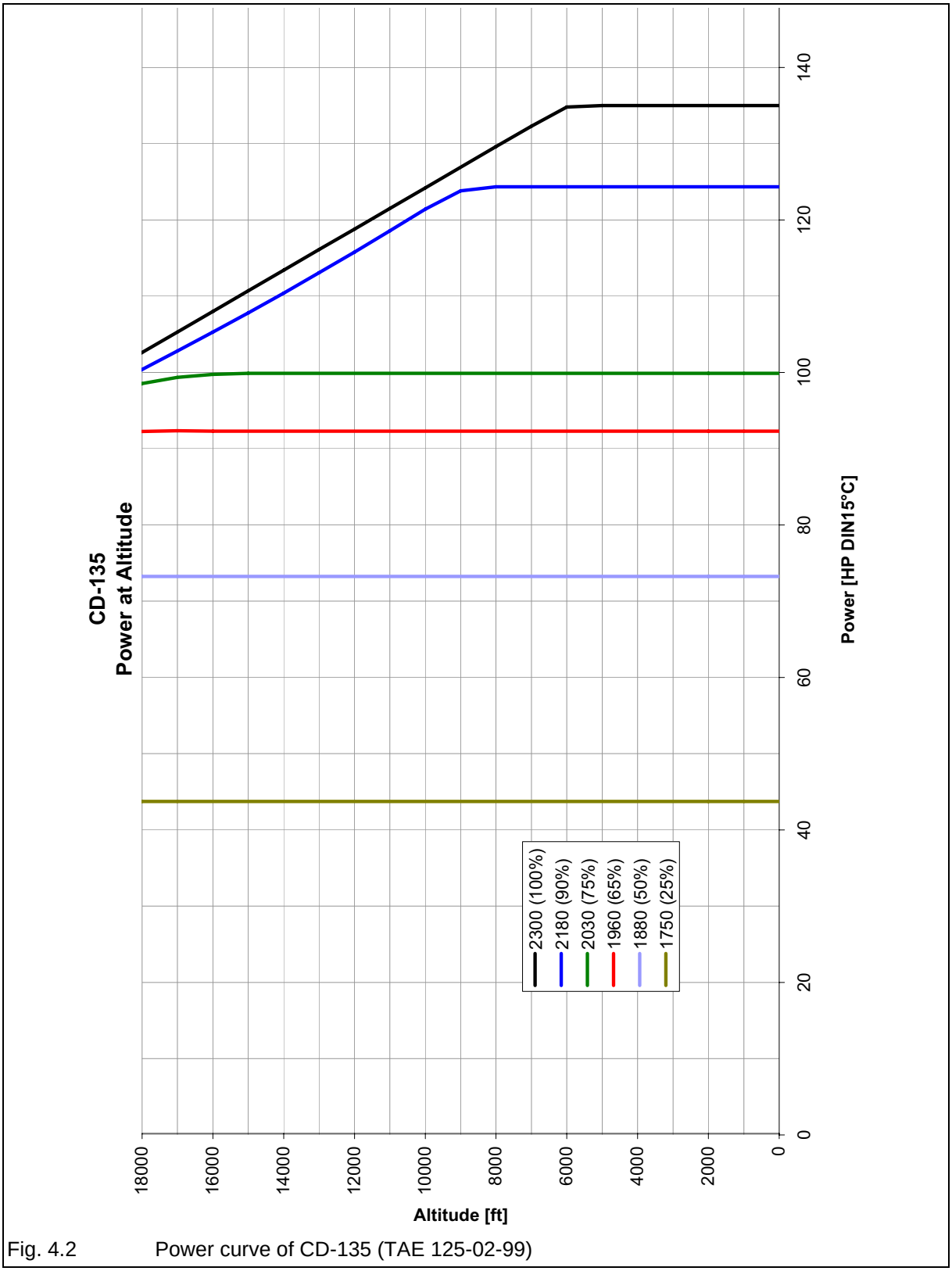

Fig. 4.2 Power curve of CD-135 (TAE 125-02-99)

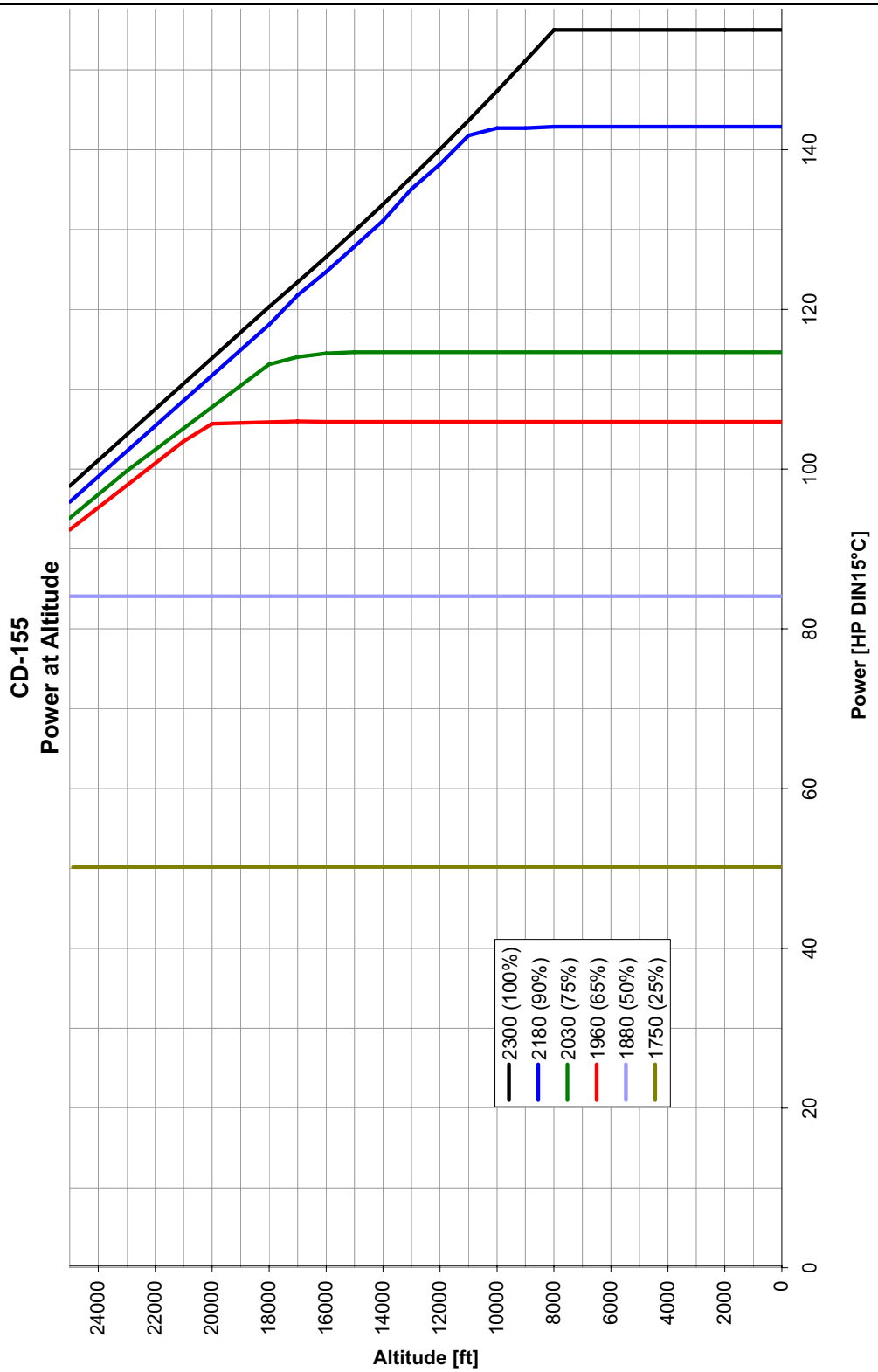

Fig. 4.3 Power curve of CD-155 (TAE 125-02-114)

4.6 Low Temperature Data and Climate Classes of Diesel in Europe

◆ Note: The officially published values in EN 590 must be observed.

◆ Note: The minimum opening-up fuel temperature in the tank can be lowered from -5°C to -10°C if Liqui Moly "Diesel Fliess-Fit" is added according to the application and dose specifications of Liqui Moly.

This page intentionally left blank

5 Transport and Packaging

5.1 Packaging

The engine has been packaged at the factory for transport as follows:

- Mounted on a support in a wooden crate.

◆ Note: The packaging should be kept for reuse in a possible future shipment.

5.2 Transport

- The engine may only be lifted by the transport eyelets (see Fig. 5.1, Fig. 5.2 and Fig. 5.3).
- The lifting device used must be suitable for the weight of the engine.

Fig. 5.1 Lifting eyelet at gearbox

◆ Note: Demount the lifting eyelet at the cylinder head cover (see Fig. 5.2) after installing the engine to the engine mount.

Fig. 5.2 Lifting eyelet at cylinder head cover

Fig. 5.3 Lifting eyelet at cylinder head

◆ Note: A suitable container should be built for transport.
A drawing for building a suitable transport container or the transport container itself can be purchased from Technify Motors GmbH.

5.3 Protective Covers

All engine openings are protected against ingress of dirt and moisture.

▲ **WARNING:** The protective covers are only intended for transport and installation. All protective covers shall be removed before taking the engine into operation, even for testing purposes.

◆ Note: It is advisable to remove the protective plugs just before the installation of the individual feed lines.

◆ Note: The transport equipment and protective plugs should be retained. If the engine has to be returned to the manufacturer at a later date, the transport equipment and protective plugs must be used.

5.4 Preservation of the Engine

◆ Note: See OM-02-02, Chapter 1, Section 1.8 for further information.

This page intentionally left blank

6 Engine Mounting and Installation Position

6.1 General

▲ **WARNING:** The engine must be mounted on all three engine mounting points.

■ CAUTION: The installation of the engine must be performed in a safe and controlled manner at all times. Please take into account the total weight of the engine.

◆ Note: Applicability of the components from the aircraft manufacturer shall be made sure in accordance with JAR 23, FAR 23 and CS 23.

6.2 Center of Gravity of the Engine

x-coordinate of the center of gravity [mm]:..... X = 369.64
y-coordinate of the center of gravity [mm]:..... Y = -17.01
z-coordinate of the center of gravity [mm]:..... Z = -90.23

▲ **WARNING:** Consider that the center of gravity of the overall installation will be shifted with the installation of the propeller and other auxiliary equipment which is not part of the engine's scope of supply.

◆ Note: The location of the center of gravity of the dry engine is given in relation to the propeller flange. For information about the coordinate system refer to Chapter 3, Section 3.4, Page 2 of this Manual.

6.3 Location of the Engine Mounts

Engine Mount	x-axis	y-axis	z-axis
Mount 1 (LH, flight direction)	761	-234(*)	-275
Mount 2 (RH, flight direction)	685	344	-159
Mount 3 (front)	308	19	-339

Table 1 Location of the Engine Mounts

(refer to the engine views in Chapter 02-OM-03-02)
(*) to central axis of engine mount; -269 mm to stud

For Diamond DA 42:

Engine Mount	x-axis	y-axis	z-axis
Mount 1 (LH, flight direction)	761	-234(*)	-275
Mount 2 (RH, flight direction)	696	286	-149
Mount 3 (front)	308	19	-339

Table 6.1 Location of the Engine Mounts (DA 42)

(refer to the engine views in Chapter 02-OM-03-02)
(*) to central axis of engine mount; -269 mm to stud

▲ **WARNING:** The maximum operating loads on the engine mounts have to be supported reliably by the engine frame and the housing mounts. Make sure, that frame and housing are sufficiently designed for the operating loads.

6.4 Permissible Loads at the Engine Mounts

▲ **WARNING:** All engine mounting bolts must be tightened to the tightening torque specified in the aircraft manufacturer's instructions.
Only the approved mounting bolts must be used.

■ CAUTION: The proof of compliance for certification of the engine frame and the housing mounts according to the applicable certification requirements like JAR and FAR has to be shown by the aircraft or airframe manufacturer. Only approved engine frames must be used.

Engine bearings	+X	-X	+Y	-Y	+Z	-Z
Bearing 1	-	7.9	2.7	2.7	4.7	4.0
Bearing 2	-	3.2	1.1	1.1	1.9	1.6
Bearing 3	-	10.8	3.6	3.6	6.4	5.4

Table 6.2 Maximum loads permitted at the engine mounts [kN]

6.5 Permissible Installation Positions

This engine is only designed for pull propeller installations.
The propeller shaft must lie above the crankshaft and point towards the front in the direction of flight (x-axis). The installation position of the engine is given by the definition of the engine mounts (refer to 6.3, Page 2 of this Chapter). Deviations from this position are possible within a range defined by a rotation around the x-axis by +14°/-2°, the y-axis by +5°/0° and around the z-axis (vertical axis) by ±5°, or as a combination of these rotations.

6.6 General Information on Engine Mounting

- To isolate vibrations, the supplied shock mounts must be installed between engine and airframe.

▲ **WARNING:** In any cases, the engine mount must be tested with ground runs related to vibration behaviour and with static tests to the prescribed loads. The proof of compliance for certification of the engine frame and the housing mounts according to the applicable certification requirements like JAR and FAR has to be shown by the aircraft or airframe manufacturer.
Only tested and approved engine mounts must be used. The use of unsuitable engine mounts can cause serious damage to the engine and airframe or even cause the aircraft to crash.

◆ Note: The engine mount must be designed to avoid excessive engine vibrations, excessive noise and vibrations from the airframe side.

7 Exhaust System

7.1 General

◆ Note: Applicability of the components from the aircraft manufacturer shall be made sure in accordance with JAR 23, FAR 23 and CS 23.

7.2 Design of the Exhaust System

The design and installation of the exhaust system is determined mainly by the available space for installing it in the aircraft.
Interface is the turbocharger and the integral manifold. Two different versions of turbochargers are possible, K16 turbocharger or V22 turbocharger (older version). Integral manifold depends on the aircraft and the turbocharger version.

▲ **WARNING:** EXTREME FIRE HAZARD!
The exhaust system must be installed in such a way that there is no risk of any aircraft or engine components being ignited or inflamed.

■ CAUTION: No kinks in the exhaust system are allowed. Unnecessary bends have to be avoided.

Permissible forces and moments affecting the exhaust flange:

Max. permissible forces in the x, y and z-directions..... 300 Nm

Max. permissible bending moments
in the x- and y-directions ..... 2.5 Nm

Max. permissible bending moment in the z-direction ..... 10 Nm

▲ **WARNING:** If possible, the exhaust pipe should not be supported by additional mountings. If additional support is unavoidable, then the exhaust pipe must be attached with the aid of compensator's due to different vibrations of engine and engine mount.

Fig. 7.1 Example of a possible installation of the exhaust pipe

7.3 Requirements for the Exhaust System

A muffler is not required.

Back pressure at maximum power:.....max. 0.1 bar

An inner diameter of 57 mm of the exhaust pipe is recommended.

▲ **WARNING:** The exhaust system must have a minimum temperature resistance of 800°C!

■ CAUTION: HOT SURFACE!
Due to occurring high temperatures, avoid contact with hot surfaces by wearing appropriate protective clothing.

■ CAUTION: The exhaust system has to be secured appropriately according to its installation position.

■ CAUTION: The surroundings of the turbocharger and the exhaust system should be protected with suitable heat shields.

7.4 General Information on the Exhaust System

A frequent cause for vibrations on the exhaust system is improper installation and maintenance.
With regard to the airframe installation situation, on the airframe side an additional protection of the exhaust system with vibration damping elements shall be provided.
Installation of a heater, using the exhaust pipe, is not permitted.
The engine has a connection for a water heat exchanger.

▲ **WARNING:** Excessive tension at exhaust system mounting points could cause cracks and be a potential fire hazard!

This page intentionally left blank

8 Cooling System

8.1 General

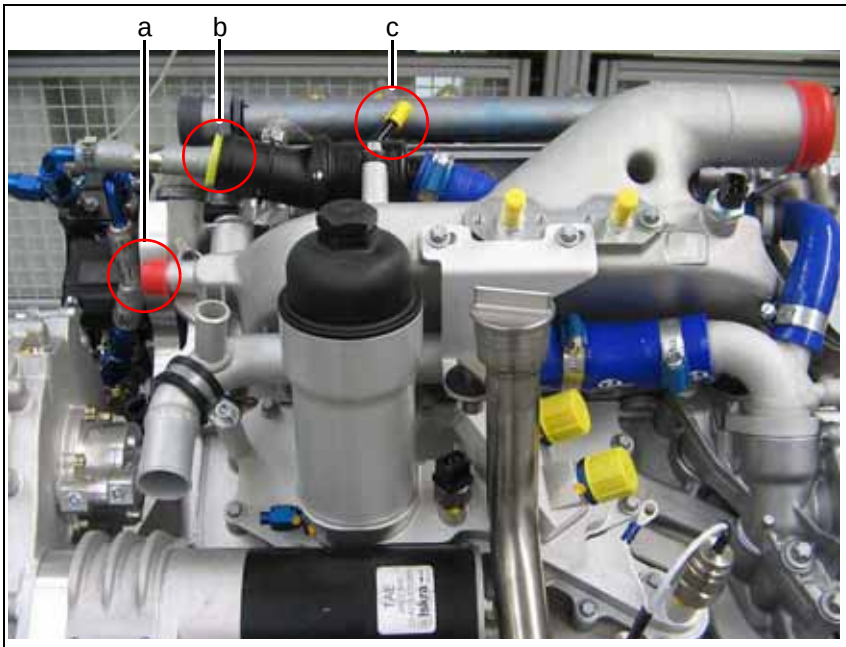

Fig. 8.1 Interface cooling circuit CD-135

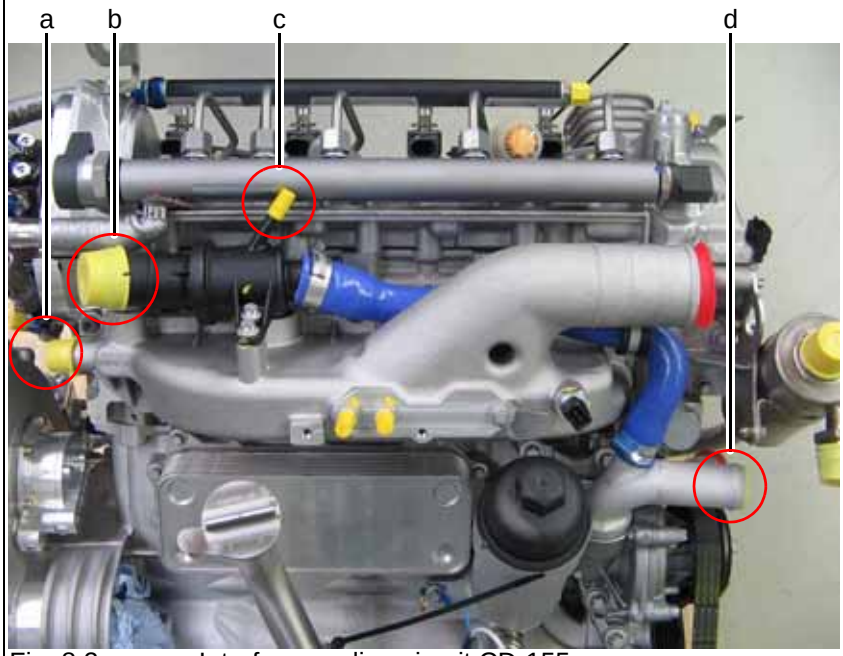

Fig. 8.2 Interface cooling circuit CD-155

a Heatings Circuit Engine Outlet
b Main Circiut Engine Outlet
c Small Circuit Engine Outlet
d Coolant Return

◆ Note:	Applicability of the components from the aircraft manufacturer shall be made sure in accordance with JAR 23, FAR 23 and CS 23.
	The following components are not part of the scope of supply, but are required for installation: • Water Cooler • Coolant hoses • Expansion Tank
◆ Note:	The expansion tank has got an integrated coolant level sensor.
	• Cartridge provided with silicate pouch (order number for silicate pouch: P/N 40-7520-H0024xx)
◆ Note:	The the silicate pouch needs to be changed every 3000 hours or at least every 6 years.

8.2 Requirements for the Cooling System

▲ **WARNING:** The coolant system must ensure that the engine operating limits are not exceeded.

▲ **WARNING:** There must be no loss of coolant during operation. Any coolant loss must be rectified immediately. Risk of engine damage!

■ CAUTION: Secure all hoses and hose connections against slipping.

■ CAUTION: Ensure that all tubes and tube connections of the coolant system show no leakage at all.

Coolant hoses:

Temperature stability:.....min. -40°C to 140°C
Pressure durability: .....min. 3 bar
Inner diameter: ..... min. 25 mm to max. 34 mm
Material: ..... 3-layer silicone 100% suitable for glycol and antifreeze. Ensure resistance to ozone.

■ CAUTION: Only suitable and standardized hoses, clamps and tubes may be used.

■ CAUTION: The welding directives for aviation must be observed. Welding work must only be performed by specially trained and certified personnel.

◆ Note: The use of hose clamps which comply with ABA 265 DIN is recommended.

◆ Note: Instead of longer hoses use aluminum tubes (inner diameter of min. Ø25 mm to max. Ø34 mm).

Water Cooler:

Temperature stability:.....min. -40°C to 140°C
Pressure durability: .....min. 3 bar
Cooling power CD-135:.....min. 31 kW
Cooling power CD-155:.....min. 52 kW
Volume flow:..... min. 90 l/min at 3900 rpm (engine speed)
and 99kW/114kW (max. power)
Max. pressure ∆: .....0.25 bar at 90 l/min

Expansion Tank:

Temperature stability:.....min. -40°C to 140°C
Pressure durability: .....min. 3 bar
Material: .....100% suited for glycol
and anti-freeze.
Ensure resistance to ozone.
Expansion volume:.....min. 1 Liter of which 50%
is residual air (with cold coolant)

8.3 Dimension and Location of Connections

■ CAUTION: In order to make sure proper function of the closed cooling system, it is necessary to install the expansion tank with pressure cap at the highest position in all permissible engine positions.
The overflow line of the expansion tank can be routed into the open.

Bleed line

Fig. 8.3 Bleed line connection
a Bleed line connection

- From the highest point of the radiator a bleed line to the expansion tank (refer to Fig. 8.3) has to be provided.
- The inner diameter is 3 mm.
- The inlet must be positioned above the maximum fill level of the expansion tank.
- The drain from the expansion tank has to be provided at least 10 mm into the collection point in front of the water pump (refer to Fig. 8.3).

Coolant hose line to the water cooler

Fig. 8.4 Coolant hose connection CD-135 Radiator Inlet)

Fig. 8.5 Coolant hose connection CD-155 (Radiator Inlet)

- The connection of the coolant hose is provided by a hose connection at the thermostat.
- The plastic connecting piece of the thermostat has a diameter of 31.5 mm (refer to Fig. 8.4).

Coolant hose line from the water cooler

Fig. 8.6 Coolant hose connection CD-135 (Radiator Outlet)
a Interface of the water pipe to the coolant radiator

Fig. 8.7 Coolant hose connection CD-155 (Radiator Outlet)

- The hoses of the cooling circuit are not part of the scope of supply, with the exception of the hose from the water pipe to the coolant thermostat.
- The interface of the water pipe to the coolant radiator.

Coolant supply line from the expansion tank

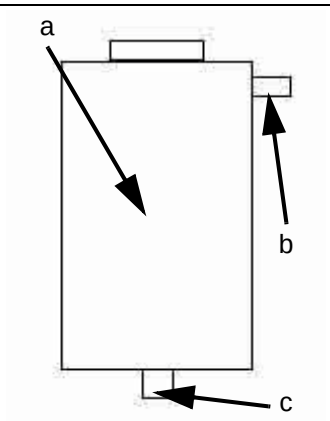

Fig. 8.8 Coolant supply line from the expansion tank

a Expansion tank
b Bleed line connection
c Small cooling circuit connection

- From the expansion tank a connection line of at least Ø10 mm with continuous slope to coolant inlet into the general coolant return connection has to be provided.
- When using coolant Glysantin G05 or Glysantin G48, a cartridge with silicate pouch
(order no. silicate pouch: 30-7220-08300Rx) should either be installed within the expansion tank or in the line from the expansion tank to the water pump.

◆ Note: The expansion tank must have a minimum volume of 1 l. In its cold state it must be half-filled with coolant.

◆ Note: The cap of the expansion tank must be designed for a pressure of 1.8 bar +0.5/-0 bar (relative).

◆ Note: It must be ensured that the coolant flow through this connection is not obstructed, i.e. the lines must be free of kinks and should installed as straight as possible, etc.

Heating supply and return lines

Fig. 8.9 Heating lines CD-135

Fig. 8.10 Heating supply line CD-155

A heat exchanger can be connected to the engine serving as a heating unit.
The heating water feed shall be taken from the upper thermostat connection. See Fig. 8.3.
The plastic connection piece on the thermostat has an outer diameter of 8 mm (with beaded rim 12 mm).

The CD-155 version uses an additional gearbox oil heat exchanger, which heats and cools the gearbox oil. See Fig. 8.10.

The heating return has to be fed into the general coolant return connection in the water pump intake on the engine side.

8.4 Coolant

Coolant: ..... Water / Radiator Protection

refer to
Chapter 4, Section 4.4, Page 5 of this Manual

▲ **WARNING:** If the ice flocculation point of the coolant is outside the specified range, the full anti-corrosion and anti-freeze protection is possibly not guaranteed.

■ CAUTION: The exchange to the respectively other approved coolant demands the installation or demounting of the silicate pouch, this depends on the used coolant. Observe the other caution notes of this section.

■ CAUTION: The water must meet the following requirements:

1. Visual appearance: colorless, clear, no deposits allowed
2. pH-value: 6.5 to 8.5
3. Water hardness: max. 2.7 mmol/l
4. Hydrogen carbonate: max. 100 mg/l
5. Chloride concentration: max. 100 mg/l
6. Sulfate concentration: max. 100 mg/l

◆ Note: It is recommended to use Glysantin Protect Plus Ready-Mix and Glysantin Alu Protect Ready-Mix respectively to ensure proper coolant quality.

◆ Note: The ice floccuation point of the coolant is -38°C, if mixed 50:50. Glysantin G48 is an anti-corrosion and anti-freeze additive. The ice flocculation point must be -38°C +/-2°C. If the freezing point is outside this range the coolant has to be exchanged.

8.5 General Information about the Coolant System

The proof of compliance for certification of the required coolant system components according to the applicable requirements like JAR, FAR or CS has to be accomplished by the aircraft or airframe manufacturer.
The suitability of materials used in the coolant system has to be shown within this proof.

8.6 Display Instrument: Requirements and Connections

Water temperature sensor and a appropriate display instrument

- The display instrument is not part of the scope of supply.
- The display instrument must have color ranges as shown in Table 1.

Coolant Temperature Color Ranges					
Color	Range				Description
	Min in °C	Max in °C	Min in °F	Max in °F	
Amber	-32	60	-26	140	Low
Green	60	101	140	213	Normal
Amber	>101	105	>213	221	High
Red	>105	115	>221	240	Very High

Table 1

- The display accuracy at lower limit of the red range 105°C, respectively 221°F, must be ±5°C or better, respectively ±9°F or better.
- Data can be taken from the CAN connector of the ECU. Related information can be obtained via Technify Motors GmbH.

◆ Note: Technify Motors GmbH offers a certified engine display to monitor all relevant engine parameters.
The order no. is 02-7730-5501-()-() which can be used to monitor all of the engine parameters. This display is certified in accordance with JTSO-C113 by the Luftfahrt-Bundesamt.

8.7 Inspection of the Coolant System

The coolant system has to be inspected after installation as follows:

- Perform a pressure test with a minimum pressure of 3.0 bar (absolute) and 2.0 bar over pressure. Duration: 2 minutes. Afterwards check for leakage (refer to the aircraft manufacturers specification).
- Finally, the tightness is checked with the engine test run.
- Check the ethylene glycol concentration of the coolant.

◆ Note: The coolant level may not decrease.

9 Cooling Air Duct System

9.1 General

◆ Note: Applicability of the components from the aircraft manufacturer shall be made sure in accordance with JAR 23, FAR 23 and CS 23.

The engine is equipped with a coolant system with a cooling air duct system.
A sufficient supply of cooling air to the radiator and intercooler is vital for the operation of the engine.

9.2 Requirements for the Cooling Air Duct System

The cooling air duct system has to be designed to make sure that the permissible surface temperatures of the individual components are not exceeded.
The regulations of the aircraft manufacturer and the supervisory authorities must be observed.

Component	Maximum permissible surface / cooling air temperature
Belt drive (belt, crankshaft vibration dampers and pulleys)	85°C
Oil filter (o-ring)	140°C
Alternator	107°C On the metal housing, or the air inlet temperature depending on altitude (refer to the diagram in Fig. 9.1)
Starter	85°C
Electrical plug-in connections, wires and sensors	85°C
Engine shock mounts (rubber)	80°C
Injectors	110°C
Vacuum line to the turbocharger	85°C
Vacuum regulator	85°C
Coolant thermostat housing	105°C
Coolant hoses	105°C
Gearbox (bearings and seals to the clutch)	120°C

Component	Maximum permissible surface / cooling air temperature
Drain hose beneath the high-pressure pump	80°C
Fuel lines	80°C
FADEC	-45°C - +70°C

■ CAUTION: The cooling air duct system has to be designed to make sure that the permissible operating temperatures (refer to Chapter 4, Section 4.3, Page 2 of this Manual) and the maximum component temperatures are not exceeded under any circumstances (refer to table above).

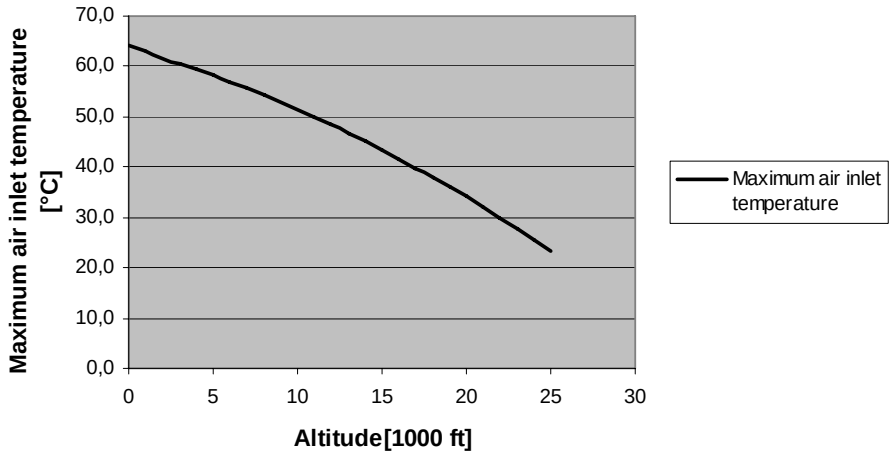

Fig. 9.1 Air inlet temperature diagram

10 Lubricating System

10.1 General

◆ Note: Applicability of the components from the aircraft manufacturer shall be ensured in accordance with JAR 23, FAR 23 and CS 23.

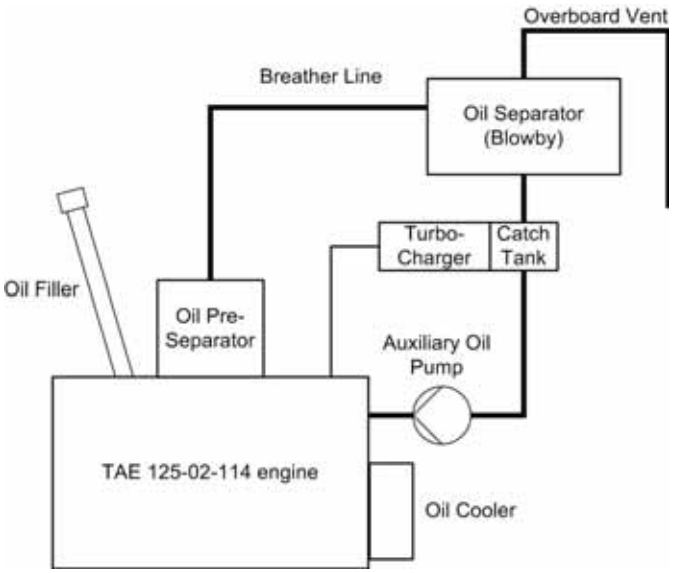

Fig. 10.1 Oil System Schematic with Blowby

10.2 Requirements for the Lubricating System (CD-135 only)

◆ Note: The CD-155 version is equipped with an integrated oil-water heat exchanger.

■ CAUTION: The installations must be designed to ensure that the permissible operating temperatures are not exceeded.

Oil cooler:

Temperature stability:.....min. 150°C
Pressure durability: .....min. 10 bar
Cooling power: .....min. 10 kW at 99 kW
min. 13 kW at 114 kW
Volume flow: ..... min. 14 l / min at 3900 rpm (engine speed)
and at 99 kW (max. power)
min. 20 l / min at 3900 rpm (engine speed)
and at 114 kW (max. power)
Max pressure Δ: .....0.55 bar at 14 l/min

Oil lines to oil cooler:

Temperature stability:.....min. 150°C
Pressure durability: .....min. 10 bar
Bending radius: .....min. 40 mm
Oil line diameter: ..... adequate to the corresponding
Dash 10 connections..

▲ **WARNING:** A reduction of the diameter over the whole length of the line is not permitted.
Refer to Section 10.4, Page 4 of this Chapter for hose lengths.

▲ **WARNING:** If the diameter of the oil line is too small, this could cause an engine damage.

■ CAUTION: Only standardized lines and connections which are approved for this purpose may be used.

Crankcase breather line:
Blowby crankcase breather:..... max. 200 l/h
Temperature stability:.....min. 150°C
Pressure durability: .....min. 7 bar

■ CAUTION: Care should be taken to ensure that no suction is developed in the lubricating system.

10.3 Integrated Oil Separator (CD-135 only)

As an option, the CD-155 Lubrication System can have an internal centrifugal oil separator located in the cylinder head.
If no mechanical vacuum pump is installed the centrifugal oil separator is located in this position.
In this case the blowby and the blowby hoses are omitted.

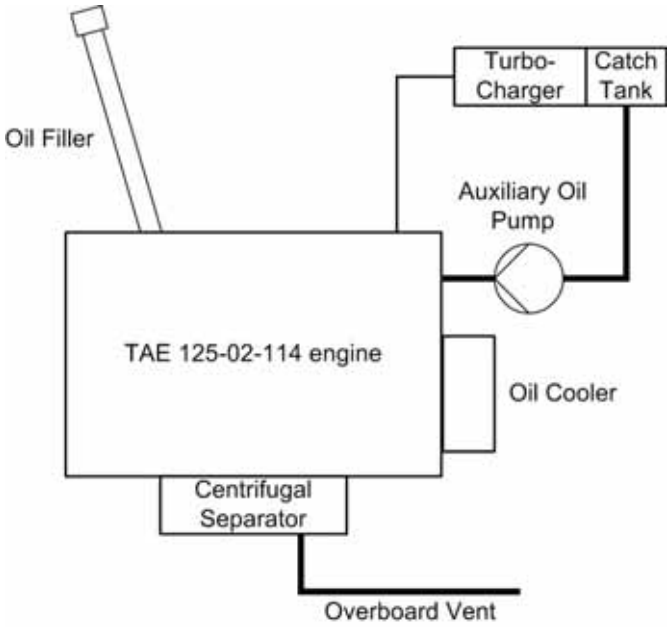

Fig. 10.2 Oil System Schematic with Integrated Oil Separator

Fig. 10.3 Integrated Oil Separator

10.4 Connections: Dimensions, Location and Length of Hoses

10.4.1 Breather crankcase

Fig. 10.4 Breather crankcase CD-135 and CD-155

a Blowby inlet
b Blowby discharge
c Blowby return

The blowby connection shall be conducted with Dash12 at the oil pan and shall be fed into the blowby oil separator, then the oil returned to the oil pan.
The blowby (discharge) should be lead outside of the cowling.
The hose lengths must be within the following tolerance range:

Dash12 discharge hose: ..... min. 300 mm
max. 2000 mm

Dash12 inlet hose: ..... min. 300 mm
max. 1500 mm

Hose, oil return to turbocharger (Dash06):..... min. 500 mm
max. 2000 mm

Tightening torques for the Dash connections:

Dash06 (Aluminum) ..... min. 17 Nm
max. 22 Nm
Dash06 (Stainless Steel)..... min. 24 Nm
max. 32 Nm
Dash12 (Aluminum) ..... min. 52 Nm
max. 62 Nm
Dash12 (Stainless Steel)..... min. 97 Nm
max. 112 Nm

◆ Note: The tightening torque of aluminum will be used on different paired materials.

◆ Note: Technify Motors GmbH offers an appropriate oil separator under the P/N 02-7250-18100Rx, P/N 50-7250-H0016xx and P/N 05-7254-K0002xx.

10.4.2 Oil Cooler (CD-135 only)

Fig. 10.5 Oil Cooler connections
a oil cooler to oil thermostat
b oil thermostat to oil cooler

The oil cooler hoses are connected to the oil thermostat with a Dash10 connection. The hose lengths must be within the following tolerance range:

Hoses to and from the oil cooler: ..... min. 300 mm
max. 1000 mm

Tightening torque for the Dash connections:

Dash10 (Aluminum) ..... min. 41 Nm
max. 48 Nm

Dash10 (Stainless Steel)..... min. 70 Nm
max. 84 Nm

◆ Note: The tightening torque of aluminum will be used on different paired materials.

10.5 Display Instruments: Requirements and Connections

10.5.1 Requirements for the display instrument

◆ Note: The display instrument is not part of the scope of supply.

The display instrument must have color ranges as shown in Table 10.1.

Oil Temperature Color Ranges					
Color	Range				Description
	Min in °C	Max in °C	Min in °F	Max in °F	
Amber	-32	<50	-26	<122	Low
Green	50	130	122	266	Normal
Amber	>130	140	266	284	High
Red	>140	150	>284	302	Very High

Table 10.1 Oil Temperature Color Ranges

The display accuracy at lower limit of the red range 140°C, respectively 284°F, must be ±5°C or better, respectively ±9°F or better.
Data can be taken from the CAN connector of the FADEC.
Related information can be obtained via Technify Motors GmbH.

◆ Note: Technify Motors GmbH offers a certified engine display to monitor all relevant engine parameters.
The order no. is 02-7730-5501-(xx)-(xx) which can be used to monitor all of the engine parameters. This display is certified in accordance with JTSO-C113 by the Luftfahrt-Bundesamt.

10.5.2 Oil pressure sensor and appropriate display instrument

◆ Note: The display instrument is not part of the scope of supply.

The display instrument must have color ranges as shown in Table 10.2.

Oil Pressure Color Ranges					
Color	Range				Description
	Min in bar	Max in bar	Min in PSI	Max in PSI	
Red	0	1	0	15	Very low
Amber	1	2.3	15	34	Low
Green	> 2.3	6	> 34	87	Normal
Amber	> 6	6.5	> 87	94	High
Red	> 6.5	7	> 94	102	Very High

Table 10.2 Oil Pressure Color Ranges

The display accuracy at the limits of the red range (1 bar and 6.5 bar, respectively 15 PSI and 94 PSI) must be ± 0.25 bar or better, respectively ± 4 PSI or better.

◆ Note: Technify Motors GmbH offers a certified engine display to monitor all relevant engine parameters.
The order no. is 02-7730-5501-(xx)-(xx) which can be used to monitor all of the engine parameters. This display is certified in accordance with JTSO-C113 by the Luftfahrt-Bundesamt.

11 Fuel System

11.1 General

◆ Note: Applicability of the components from the aircraft manufacturer shall be ensured in accordance with JAR 23, FAR 23 and CS 23.

The scope of supply of the engine includes the following:

- the fuel pumps operated by the engine and
- the injection system including the collecting return lines.

The fuel feed line from the tank to the suction connection of the feed pump operated by the engine and the return line to the tank are not a part of the scope of supply.
This scope consists of the following components:

- Tank
- Fuel filter
- Water separator
- Fuel shut-off valve
- Additional electrical pump
- Tank thermometer with sensor
- Required fuel lines and connections

▲ **WARNING:** If leaks appear and air penetrates into the fuel system, the fuel pumps and the injection system could be damaged.

▲ **WARNING:** When installing the individual components of the fuel system, ensure absolute cleanliness. Running the fuel pumps dry can damage them.

■ CAUTION: The proof of compliance for certification of the components which are not included in the scope of supply according to the applicable requirements like JAR, FAR or CS has to be accomplished by the aircraft or airframe manufacturer.

11.2 Requirements for the Fuel System

11.2.1 General information

▲ **WARNING:** The fuel system must be designed, that all operating limits are observed.

The complete fuel system must be designed for a temperature range from -40°C to +120°C.

Rotational speed [rpm]*	Load	Return volume [l/min]	Max. quantity of heat [J/s]**
1500	Idle	1.45	302
3400	max. Load	1.90	1758
3900	max. Load	1.92	1976

Fuel heating at a reference temperature of 25°C
* Engine speed
** Joule / second = Watt

The fuel inlet temperature at the feed pump is limited to max. 60°C.
The aircraft fuel system must be designed, that there is a minimum absolute pressure of 675 mbar (absolute) at sea level at the intake of the feed pump at all engine operating points.
In all permissible flight attitudes up to the maximum operating altitude the fuel pressure at the intake of the feed pump must be at least 200 mbar (absolute).
When using additional pumps, a maximum absolute pressure of 3 bar must not be exceeded at the intake of the feed pump.

Fuel pressure (intake of feed pump): .....min. 0.2 bar
(absolute at maximum-load and
at the maximum service ceiling)
min. 675 mbar (absolute at MSL)
max. 3 bar

11.2.2 Lines

▲ **WARNING:** All of the aircraft's fuel lines must be pressure resistant. The pressure resistance value depends upon the fuel system of the aircraft. If only the engine's own pumps are used, the aircraft's fuel lines have to be designed for a compression strength of 2 bar.

Pumping capacity: ..... min. 150 l/h
in any approved flight altitude
from MSL up to service ceiling

Fuel lines: ..... min. diameter 5 mm

▲ **WARNING:** The fuel lines have to be installed away from hot engine components without kinks and protected appropriately, since otherwise fire hazard exists.

■ CAUTION: Only hoses, lines and joints approved for aviation purposes may be used.

The entire fuel system must be designed to be "Fire-Resistant" as a minimum.
In the event of fire, it must be ensured that fuel cannot be pumped into the designated fire zone (engine compartment). Accordingly, it must be possible to shut off the feed and return line. This can be done for example with a combined fuel shut-off valve.

11.2.3 Drain module

The fuel system must be designed in a way, that all points where condensation water and contamination could collect, can be drained.
Within the fuel system, the drain module has to be the lowest point.

▲ **WARNING:** The drain module must be designed to allow drainage of condensation water within the fuel system as part of the daily pre-flight check.

11.2.4 Fuel filter module

The fuel filter has to be selected, that even after 60 hours of solid contaminated fuel operation according to MIL 5007D and 10 hours of water contaminated fuel operation under icing conditions according to CS-E 670 there is sufficient fuel for safe engine operation. The fuel filter module has to be exchanged according to Chapter 6 of OM-02-02, check also Chapter 5 of OM-02-02 if applicable. Should the exchange interval be extended, appropriate validation must be accomplished.

Fuel filter:

Filter surface: .....min. 4000 cm^2

MFP:.....11±2 µm

11.2.5 Combined drain and fuel filter module (Technify Motors GmbH)

Technify Motors GmbH offers a combined drain and fuel filter module which has been certified for the specified requirements. The appropriate fuel filter module and element can be ordered at Technify Motors GmbH. For further information please contact Technify Motors GmbH.

▲ **WARNING:** The thermostat-controlled combined drain and fuel filter module (Technify Motors GmbH) must be at least 30 cm below the feed pump level!
Continuous filter systems which are not multi-way systems can be installed max. 15 cm above the feed pump level.

11.3 Connecting Points and Dimensions

11.3.1 Fuel intake

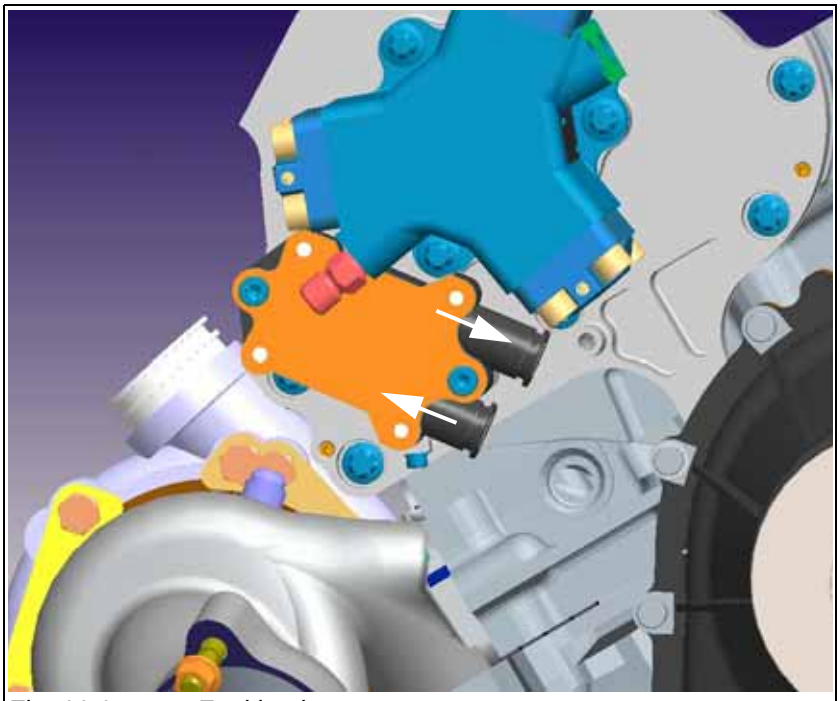

Fig. 11.1 Fuel intake

The fuel is fed on the propeller side of the engine on the advance feed pump. The interface to the feed line is defined at the suction connection of the engine driven feed pump. Dash06 has to be selected as connection at the pump.

Tightening torque for the Dash connection:

Dash06 (Aluminum) ..... min. 17 Nm
max. 22 Nm
Dash06 (Stainless Steel)..... min. 24 Nm
max. 32 Nm

■ CAUTION: When installing the intake line to the fuel pump, ensure that no additional torques or forces are exerted on the pump and that the lines are sufficiently protected against vibrations.

◆ Note: The tightening torque of aluminum will be used on different paired materials.

11.3.2 Fuel return

The fuel is returned on the belt side of the engine. The interface of the return line is at the connecting T-piece of the return lines on the engine side. Dash06 has to be selected as connection on the T-piece.

Tightening torque for the Dash connection:

Dash06 (Aluminum) ..... min. 17 Nm
max. 22 Nm
Dash06 (Stainless Steel)..... min. 24 Nm
max. 32 Nm

▲ **WARNING:** **NO** components may be attached to the return pipe (refer to Fig. 11.2). Within short time, damages could occur.

▲ **WARNING:** Between fuel filter module and the fuel tanks a check valve **MUST BE** installed in the return line! Otherwise air could enter into the fuel system and cause engine damage or loss of power.

■ CAUTION: The fuel return to the tank must be unpressurized.

◆ Note: The tightening torque of aluminum will be used on different paired materials.

Fig. 11.2 Return pipe

11.4 Display Instrument: Requirements and Connections

Tank temperature sensor and an appropriate display instrument

Sensor and instrument are not included in the scope of supply. The display instrument must have color ranges as shown in Table 11.1.

Fuel Temperature Output Color Ranges					
Color	Range				Description
	Min in °C	Max in °C	Min in °F	Max in °F	
Red X		< -50		< -58	Invalid
Red	< -50	-30	-58	-22	Very low
Amber	< -30	-5	< -22	24	Low
White	-5	65	24	148	Normal
Amber	> 65	75	> 148	166	High
Red	> 75	100	> 166	212	Very High
Red X		> 100		> 212	Invalid

Table 11.1 Fuel Temperature Output Color Ranges

The operating limits for operation with JET A-1 / JET A / Jet Fuel No. 3 / JP-8 / JP-8+100 fuel must be readable.
The sensors must be appropriate for this measuring range and for use with JET A-1 / JET A / Jet Fuel No.3 / JP-8 / JP-8+100 fuel.

◆ Note: The overall accuracy on the red lines must not exceed ±5°C, respectively ±9°F.

◆ Note: The lower operating limit for the engine at -30°C only applies to JET A-1 / JET A / Jet Fuel No.3 / JP-8 / JP-8+100 operation. If an aircraft is licensed for Diesel operation, the operating limit for fuel temperature from -5°C on may not be exceeded. In this case, appropriate placards should be mounted on the tanks and instrument panel to inform the pilot.

◆ Note: When determining the minimum tank temperature for take-off with the aircraft, the country-specific and seasonal differences for Diesel mixtures must be considered.

This page intentionally left blank

12 Intake System

12.1 General

◆ Note: Applicability of the components from the aircraft manufacturer shall be made sure in accordance with JAR 23, FAR 23 and CS 23.

An air filter and charge air intercooler should be supplied for the intake system as they are not included in the scope of supply of the engine.

12.2 Intake System Requirements

12.2.1 Air filter

A minimum air flow rate of 8 m^3/min must be guaranteed under all conditions.

■ CAUTION: The filter elements must not seal up if they come into contact with water.

For example, the air filter with the P/N NM-0000-01728xx or P/N 30-7160-13120Rx (older part) meets these requirements.

12.2.2 Intercooler

▲ **WARNING:** An intercooler is required to cool down the intake air that heats up during the compression process of the turbocharger. If the intercooler does not achieve the necessary cooling, the engine loses its performance.

It is recommended that the intercooler must be configured in a way, that the intake air temperature is no more than 25K above the ambient air temperature, both during Vy-climb and at level flight. At maximum power (take-off / max. continuous) the air mass flow rate is
9 kg / min, which requires a required cooling performance of 16 kW.

Max. pressure Δ (intercooler) ..... 0.07 bar at 9 kg / min

Max. manifold air temperature: ..... 100°C

Max. manifold air temperature for 100% engine power: ..... 60°C

12.3 Connections: Dimensions and Locations

12.3.1 Air Filter to Turbocharger Compressor Housing

Connect the air filter to the turbocharger with a hose of Ø 46 mm or greater (refer to Fig. 12.1).

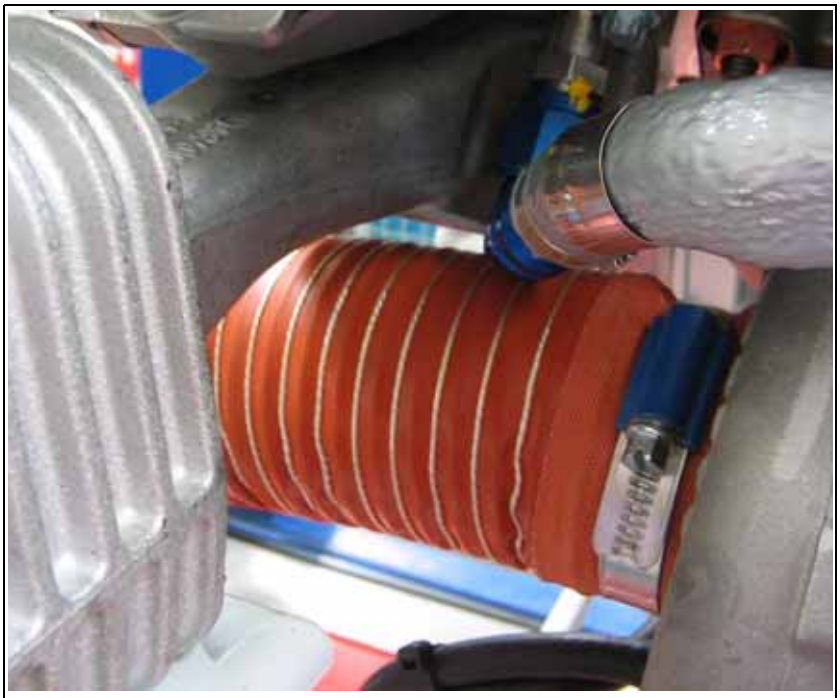

Fig. 12.1 Air hose connection at the turbocharger

12.3.2 Hoses

In the pressurized area the hoses must comply with the following minimum requirements:

- 3 layers of silicone, tough, elastic, with a long service life
- operating temperature range from -50°C to 220°C
- pressures > 2 bar relative.
- Only standardized pipes which are suited to the purpose must be used.

12.3.3 Turbocharger Compressor Housing to Intercooler

Two different turbochargers can be installed, the K16 Turbocharger or the V22 Turbocharger (older Version).

K16 Turbocharger

To connect the turbocharger to the intercooler, a adapter identical to the flange on the turbocharger (refer to Fig. 12.2) is required.

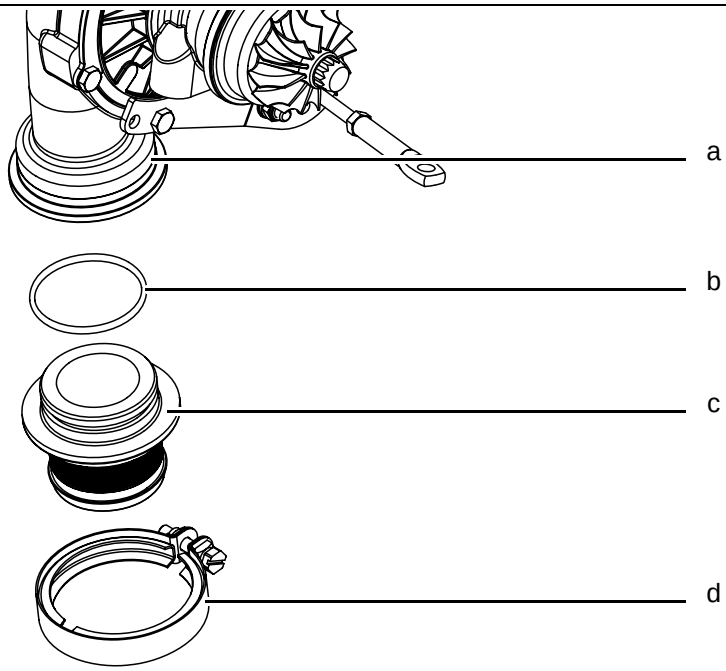

Fig. 12.2 Adapter to K16 turbocharger

a K16 turbocharger
b o-ring
c adapter
d clip

V22 Turbocharger

To connect the turbocharger to the intercooler, a flange identical to the flange on the turbocharger (refer to Fig. 12.3) is required. This flange must have a minimum length of 80 mm.

▲ **WARNING:** If the flange is shorter than 80 mm there is a risk of the hose slipping off due to the heat, causing a total loss of engine performance.

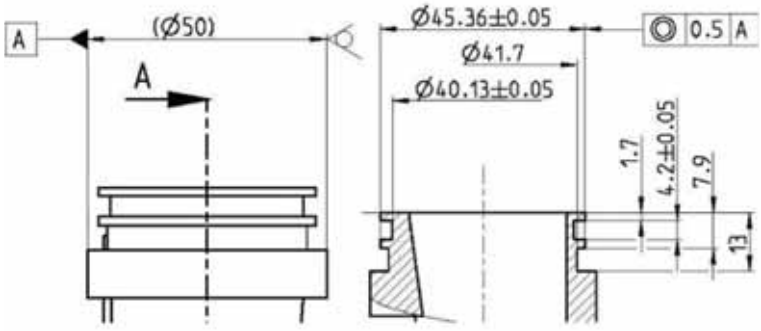

Fig. 12.3 Flange intercooler to V22 turbocharger

The turbocharger and the flange are joined with a Wiggins clamp (P/N: 52-7520-H0011 01) (refer to Fig. 12.4). The flange is connected with a pipe with an inside diameter of 50 mm.

Fig. 12.4 Connection intercooler to V22 turbocharger CD-135

Fig. 12.5 Connection intercooler to V22 turbocharger CD-155

The intercooler is connected to the intake manifold with a hose of min. Ø 48 mm (refer to Fig. 12.6).

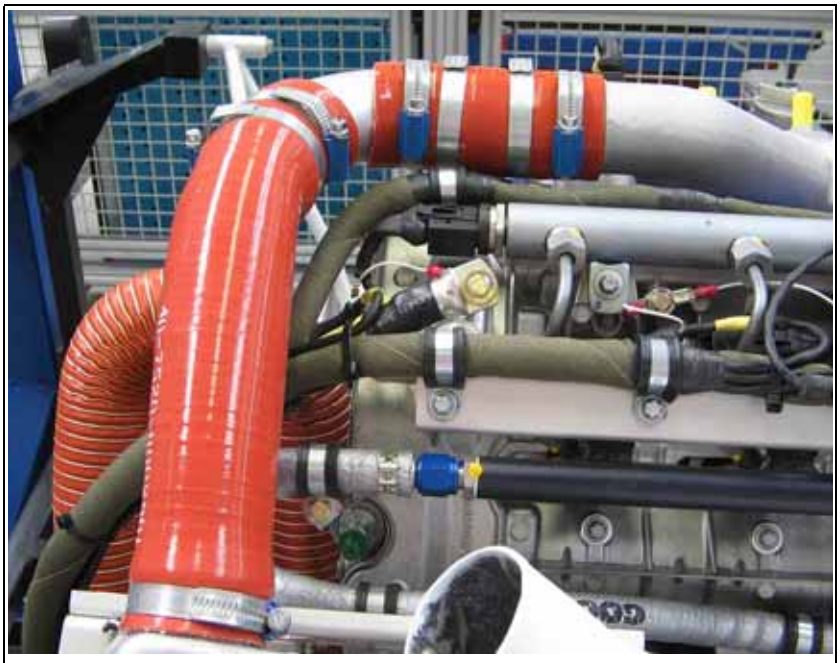

Fig. 12.6 Connection intercooler to intake manifold

■ CAUTION: Only standardized and approved lines and connections must be used.

This page intentionally left blank

13 Electrical System and FADEC Installation

13.1 General

The engine is equipped with a **F**ull **A**uthority **D**igital **E**ngine **C**ontrol unit (FADEC). The FADEC System is electrically powered and not self-excited which means the engine control unit relies on electrical power from the aircraft. The engine is already equipped with most of the necessary electrical components as standard, and it is wired with the supplied engine wiring harness.
The components described below have to be installed according to the applicable directives and laws. Refer to Section 13.3, Page 3 of this Chapter.

▲ **WARNING:** A reliable electrical supply to the CD-135 and CD-155 engine must be ensured under all circumstances. Only this enables the electronically controlled engine to function properly.
The work steps described below must be performed by qualified personnel with the utmost care.

▲ **WARNING:** When wiring the wiring harness and the entire electrical system, always ensure that the insulation does not rub against sharp edges or be scorched by hot objects.

■ CAUTION: The requirements related to the performance of the electrical system are part of the certification basis of the CD-135 and CD-155, the planned electrical system of every series production installation with this engine needs to be approved by Technify Motors GmbH in writing before taking the engine / aircraft into operation.

◆ Note: Applicability of the components from the aircraft manufacturer shall be ensured in accordance with JAR 23, FAR 23 and CS 23.

13.2 FADEC Installation General

The FADEC has to be connected to the wiring harness.
The FADEC must be installed in accordance with aviation standards relating to electromagnetic compatibility and indirect lightning requirements.
The ambient temperature for the FADEC must not be higher than 70°C. The FADEC must be installed outside of fire zones and sufficiently away from the firewall so that, in case the firewall heats up to 1100°C for 5 min, it does not lead to insecure behavior of the FADEC.
The electrical current is supplied to the redundant FADEC halves through two separate circuit breakers.

The installation position of the FADEC must be protected against water.

▲ **WARNING:** Moisture environment can cause FADEC malfunction. The FADEC is not waterproof.

Make sure that the FADEC is not the lowest point of the engine installation. Route the MAP lines so that they are the lowest point of the installation. The routing of these lines should form a water trap before reaching the connection to the FADEC. See Fig. 13.1.

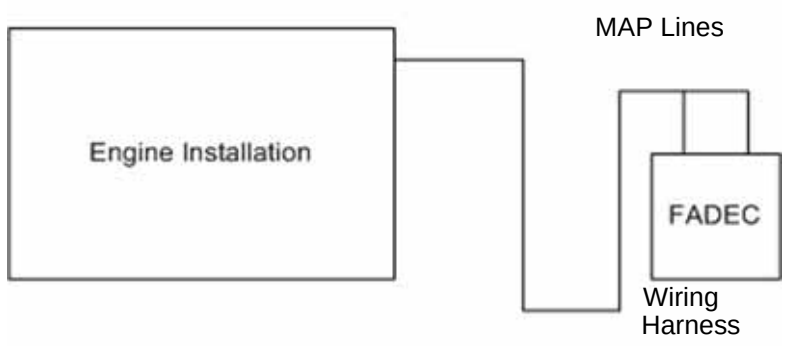

Fig. 13.1 Preferred FADEC installation

13.3 FADEC Electrical Power Supply

The electrical system must be designed in such a way that a permanent supply of the FADEC is assured. Once there is an interruption of the FADEC electrical power supply the FADEC will reboot and reinitialize. The FADEC reboot and reinitialization time is less than 1.5 seconds. This will result in Total Loss of Power events, for aircraft installations, in which the propeller automatically goes into the feather position in case of loss of electrical power to the propeller control. In configurations such as these, further requirements to the electrical system may be necessary.

Therefore the electrical system must meet the following specific requirements in order to enable installation of the CD-135 and CD-155:
A voltage supply failure in the electrical power supply of the aircraft must not result in any significant loss of performance. This means that the electrical power supply to the FADEC needs to remain intact in such cases.
This requirement is part of the certification basis of the CD-135 and CD-155 and must therefore be complied with for every installation.
A permanent sufficient electrical power supply is understood to be a supply of electric power without interruptions, not below 8V DC (12 / 24 V). Interruptions or voltage drops of electrical power supply to a voltage below 8V DC (12 / 24 V) will result in FADEC reboot and reinitialization. The electric power supply has to be compliant to the following:

Electrical Power Requirements		
Item	12V DC nominal	24 DC nominal
Voltage	9 to 16V DC	18 to 32V DC
Current	10 amps (max. 12 amps)	5 amps (max. 8 amps)
Transients	Not to exceed: 30V DC for 0.1 sec. 20V DC for 1.0 sec. Not below: 8V DC	Not to exceed: 60V DC for 0.1 sec. 40V DC for 1.0 sec. Not below: 8V DC

Table 13.2 Electrical Power Requirements

At least one FADEC half should have a voltage above 8V all the time. If this can not be assured, the aircraft manufacturer must show that a loss of thrust for 1.5 sec caused by the FADEC reset is no hazard for the aircraft. The reliability of the aircraft supplied electrical power to the FADEC is dependent on the installation and must be determined by the aircraft manufacturer. Therefore a Functional Hazard Assessment and a Failure Mode and Effect Analysis have to be prepared to identify conditions which might create a hazard to the aircraft. These assessments must take into account the possible interruption of the electrical power supply to the FADEC. For determination of system reliability FAA AC guidance material to FAR 23.1309 should be followed. The input to these analyses and their results should be coordinated between aircraft and engine manufacturer.
The reliability of the entire engine control system is at least 1 event in 54245h which is equivalent to a failure rate of 1.8434×10^{-5}.

The minimum reliability of the entire FADEC electrical power supply should assure that the probability of a total loss of thrust due to a failure or an interruption of aircraft supplied electrical power supply is compliant with the requirement of the aircraft installation.

13.4 Installation FADEC Pressure Sensor Lines

The FADEC must (additionally to the electrical installation) also be supplied with pressure connections for ambient static pressure and MAP (manifold air pressure). When designing the pressure connections, the following has to be considered:

1. All connections and pipes need to be protected against being constricted or kinked.
2. The MAP connections must be completely pressure resistant to min. 5 bar absolute. Provisions must be made that no condensed water or other fluids can ingress into the MAP connector.
3. On the ambient pressure connections, the probability of malfunctions due to the ingress of foreign substances or icing must be minimized. This can be done by e.g. connecting them to a suitable aircraft static port system or by connecting an appropriate filter upstream (such as a fuel filter).

13.5 Layout of the Electrical System

The battery (or batteries) is the source of electrical power in the electrical system of the aircraft. The alternator of the engine is defined as the engine's own electrical power source. The following are the basic rules for the design of an appropriate electrical system:

1. The FADEC, alternator and battery must therefore be wired in such a way that the FADEC power supply is still provided by the alternator in the event of failure of the aircraft electrical power system in a quality as defined in Chapter 13.3.
2. The electrical system of the engine and the electrical system of the aircraft shall be connected in a way that failures and short circuits in the electrical system of the aircraft do not lead to failure of the engine electrical system. This may be achieved by circuit breakers, fuses or by supplying FADEC A and B by independent power supplies or any other system that insures permanent power supply to at least one FADEC halve. Aircraft installations where the power supply to both FADEC halves drop below 8V for a short time are acceptable if the resulting reset of the FADEC and therefore loss of power for 1.5 sec is no hazard for the airplane.
3. It must always be possible to isolate the FADEC electrical system with the alternator both from the battery and from the rest of the electrical system of the aircraft via circuit breaker or other means.

Please refer to the relevant manufacturer's instructions for the wiring of instruments (not included in the scope of supply).

13.6 Wiring

When implementing the wiring, it is especially important to ensure that the wire cross-sections are large enough and that all crimp connections are executed with care. A power supply to the control system must be ensured at all times in the quality defined in Chapter 13.3.

To minimize voltage drops between the FADEC and other electrical equipment the ground connection supply wires need to be low resistance.

▲ **WARNING:** Improper wiring may result in reduced engine performance or even misfiring of the engine.

Switches

All of the switches and buttons must be designed and installed in conformity with JAR 23.1367.
The switches have to be labeled clearly related to their function and installed in reach of the pilots.

Electrical power consumers

Other electrical consumers not required for actual engine operation must only be connected to the system via circuit breakers or fuses to the main bus. These consumers must not consume more than nominal 70A (14V system) or nominal 35A (28V system) together.

Compliance demonstration that transients of consumers of the electrical aircraft system do not affected the FADEC electrical power supply as specified in Chapter 13.3 at any time must shown by the airframer.

Wire harness installation

When installing the wiring harness, please ensure that it is mechanically fastened at several points to prevent chafing. All wires must be routed and secured in a way which ensures that the connectors can be plugged in without tension.

■ CAUTION: No tension allowed at all!

All shielded wires must be attached via electrically conducting connections to the engine block at the actuator and sensor ends of the wiring harness. They shall also not be extended or lengthened.

■ CAUTION: Do not remove connectors!

13.7 Connecting Points Wiring harness / FADEC / Battery Relay

The installation of the battery relay should occur with the connections downwards to protect the connections from soiling or accidental contact. The grounds of the individual wires should be brought together to produce a central ground connection point. Dividing it up into several ground connection points reduces the system's immunity to interference while increasing the probability of ground defects which may lead to malfunctions and increased sensitivity to electromagnetic interference.

■ CAUTION: No changes must be made to the configuration of the supplied wiring harness as it is tested for EMC / immunity to interference.

13.8 Technical Data of the Electrical Components and their Connections

13.8.1 Internal alternator

The alternator is included in the scope of supply and is supplied as a fixed installation on the engine.

13.8.2 Wiring of the alternator

The alternator has a DC output of 12-14 V at 90A or 24-28V at 60A in the 28V system.
The connection of the main charging line to the alternator meets AWG2 or better. This size guarantees a reliable supply to the system.
The alternator shall be connected to the alternator regulator (ALTREG) and the failure warning lamp (AWL). The alternator regulator shall be installed on the cockpit side of the firewall, with the ventilation opening and the electrical connector facing down.
The warning lamp illuminates if the alternator fails or if the alternator relay is switched off while a supply voltage from the electrical system of the aircraft is present, and it normally extinguishes when the engine is started. The operating voltage of the lamp is 12V or 24V, and the connections must not be subjected to loads in excess of 1.2W.
The control lamp extinguishes at speeds greater than 1170 rpm (engine speed).
It also illuminates if the voltage drops below 11.5V (14V system) or 23V (28V system).

The color of the control lamp depends on the classification of the significance of failure of the alternator system for the overall system and is defined in the relevant design regulations.
The alternator requires an additional backup battery for the excitation voltage (excitation battery) of at least 1.2 Ah at 12V or 24V (depending on the system voltage). This battery must be integrated into the system, and it must be possible to switch this battery off.
The excitation battery must be installed in the cockpit and should be a lead-gel model with a short service interval (e.g. one year) to guarantee proper operation without additional electronic measuring devices.
One possible battery type is for example the lead-gel rechargeable battery "S312/1,2 S" from Exide Technologies supplies this type under the order number NAS31201D2VW0SC.

The alternator of the CD-135 and CD-155 was tested as follows in compliance with EUROCAE ED14D / RTCA DO160D:

Conditions	Section	Description of tests conducted
Temperature and Altitude	4.0	Alternator tested to Categories B2
Temperature Variation	5.0	Alternator tested to Category B
Humidity	6.0	Alternator tested to Category A
Operational Shock and Crash Safety	7.0	Alternator identified as Category X. Operational Shocks are tested during the 150 h endurance test of the engine
Vibration	8.0	Alternator identified as Category X. Vibrations are tested during the 150 h endurance test of the engine
Explosion	9.0	Alternator identified as Category X, no test performed
Waterproofness	10.0	Alternator identified as Category X. Alternator was tested together with the engine during the JAR-E 430 water spray test
Fluids Susceptibility	11.0	Alternator identified as Category X, no test performed
Sand and Dust	12.0	Alternator tested to Category D
Fungus	13.0	Alternator identified as Category X, no test performed
Salt Spray	14.0	Alternator tested to Category S
Magnetic Effect	15.0	Alternator identified as Category X, no test performed
Power Input	16.0	Alternator identified as Category X, no test performed
Voltage Spike	17.0	Alternator identified as Category X, no test performed
Audio Frequency Susceptibility	18.0	Alternator identified as Category X, no test performed
Induced Signal Susceptibility	19.0	Alternator identified as Category X, no test performed
Radio Frequency Susceptibility	20.0	Alternator tested to Section 20.4, Conducted Susceptibility, Category W and Category R Section 20.5, Radiated Susceptibility, Category R and Category U.
Radio Frequency Emission	21.0	Alternator tested to Category B
Lightning Induced Transient Susceptibility	22.0	Alternator identified as Category X, no test performed
Lightning Direct Effects	23.0	Alternator identified as Category X, no test performed
Icing	24.0	Alternator identified as Category X, no test performed
Electrostatic Discharge	25.0	Alternator identified as Category X, no test performed

The alternator of the CD-135 and CD-155 was tested in compliance with TIP E.80DO160-02-02 Issue 4.
In addition, the complete engine with alternator was subjected to an indirect lightning cable bundle test in accordance with EUROCAE ED14D / RTCA DO160D, Section 22, Waveform Set E, Level 5.

▲ **WARNING:** The alternator characteristic depends on its installation. The suitability of the alternator installation has to be shown in the aircraft certification.

To compensate spikes a buffer (battery or capacitor) can be installed direct connected to the alternator.

13.8.3 Voltage warning

A charge current failure warning system is not included in the scope of supply and needs to be installed additionally.
JAR 23.1165 specifies that the pilot must receive a warning if the alternator no longer supplies charging current to the battery. This could be done for example by monitoring the charging current (with an ammeter) or using a low voltage detection and warning device.
If a warning is installed, JAR 23.1322 specifies that it must be red.
The Technify Motors GmbH instrument panel AED-SR2 incorporates a charge current monitoring system with integrated low voltage detection and warning system.

13.8.4 Electrical starter

The electrical starter is included in the scope of supply and is supplied as a fixed installation on the engine. The starter is an electromotive drive device which operates at 1.7 kW in 12V DC and with 2.5 kW in 24V DC systems and is the largest consumer in the entire electrical system of the engine system. It has to be assured that the installation meets the requirements of Chapter 13.3, otherwise the engine will not start.
The starter is triggered by a starter relay.

▲ **WARNING:** The main current supply to the starter must be routed with special care. This connection cannot be protected with a fuse, so the routing must therefore ensure that there is no increased risk of fire in the event of a short circuit.

13.8.5 Starter relay

The starter relay is incorporated in the starter.

13.8.6 Starter switch

The starter switch actuate the starter. The starter switch must switch 5 A (minimum). When selecting and installing the starter switch, compliance to JAR 23.1145 is required.

13.8.7 Glow relay and glow plug control unit (GPC)

The glow relay is exclusively triggered by the FADEC, and the appropriate connections are provided with the engine wiring harness.
The relay must be suitable for loads of 30 A. It is also important to ensure that the crimped connections are of a high quality. A supply line with the appropriate cross-section is connected to the battery relay.
The installation of the glow relay is almost entirely defined by the wiring harness on the engine side. The length of the supply line from the glow relay to the battery relay should be kept as short as possible.

◆ Note: The installation should be performed in such a way that all connections are protected against chafing, vibrating and contamination with dirt.

13.8.8 Glow display

A display lamp is provided to indicate when the glow plug preheating system is active. The connection must not be subjected to loads in excess of 2W. This lamp must be designed to comply with JAR 23.1322.

13.8.9 Battery relay

The battery relay must be suitable for temporary loads in excess of 300 A and continuous loads of 100 A. It is actuated via the battery switch.

◆ Note: The locations of all relays should be chosen to ensure that they are not subjected to excessive effects from heat or pollutants.

13.8.10 Battery

The battery is not a part of the engine and belongs to the electrical system of the aircraft ("aircraft supplied power"). The battery in the 14V system must meet the following performance data requirements:

Voltage: ..... 12 V

Capacity: .....min. 35 Ah (C10)

Current: ..... temporary (5 min.)
minimum 200 A
continuous (30 min.)
minimum 40 A

A possible choice of battery is the Gill Battery G35.

▲ **WARNING:** The minimum capacity of the battery is sufficient for starter requirements and to supply FADEC and typical essential loads for 120 minutes. The actual aircraft installation must be checked, if the capacity of the battery is sufficient to supply essential loads for 120 minutes.

The battery in the 28V system must meet the following performance data requirements:

Voltage: ..... 24 V

Capacity: .....min. 10 Ah (C1)

Current: ..... temporary (1 min)
min. 100 A

A possible choice of battery is the Gill Battery G243.

▲ **WARNING:** The minimum capacity of the battery is sufficient for starter requirements and to supply FADEC and typical essential loads for 120 minutes. The actual aircraft installation must be checked, if the capacity of the battery is sufficient to supply essential loads for 120 minutes.

Another installation satisfying these minimum requirements would also be acceptable, such as one with redundant batteries.

13.8.11 Engine Master

The Engine Master switches both the power lines to the FADEC and the excitation battery connection to the alternator.

13.8.12 Main switch / Main Bus switch

The divided Master switch controls the Alternator relay and Main Bus relay. Compliance with JAR 23.1361 must be ensured when installing the Master switch.

13.8.13 Additional ground power connection

If additional external supply voltage connections are installed, they have to be equipped with reverse voltage protection in compliance with JAR 23.1351. The instructions of other equipment manufacturers have to be taken into account.

13.8.14 CAN connector

The CAN diagnostic connector is supplied with a terminating connector. This connector must be installed in a way which protects it against moisture and dirt.

■ CAUTION: When selecting the installation location for the terminating connector, make sure that it is not possible to (even accidentally) disconnect it. If you connect something to the CAN-Bus, make sure you have a bus structure.

Y-connections are not allowed for a CAN Bus. The terminating connector must be connected at the end of the bus behind the additional CAN device.

13.8.15 FADEC warning lights

These display lamps are used to warn of failure of the FADEC. JAR 23.1322 must be observed for the installation. The connected loads must not exceed 2W.

■ CAUTION: Choose the installation locations for these lamps so that they can be easily seen by the pilot. The installation must comply with JAR 23.1322.

13.8.16 Start phase monitoring

◆ Note: Only applicable for engines with Dual Mass Flywheel.

The starter is monitored using a small signal relay that is actuated via the starter button. It has a normally closed contact that needs to be installed in line with the ECU-test button as it uses the same FADEC input.
In case the starter button directly connects to the starter solenoid on the engine the signal relay coil has to be decoupled as the starter will act as a generator during shutdown. This can be achieved by either adding a high power diode with sufficient cooling between the starter button and the solenoid or by installing an additional starter relay which is actuated from the starter button. This starter relay will then source the starter solenoid separately. In both cases the signal relay has to be powered from the starter button contact.

Please refer to the following schematics (Fig. 13.2 and Fig. 13.3) or, if in doubt, contact Technify Motors GmbH for further guidance.

◆ Note: The schematic (Fig. 13.2 and Fig. 13.3) only provides the installation principles.
All parts and wiring have to be compliant to the relevant CS 23 chapters (necessary protective devices such as circuit breakers have been omitted for simplicity).
For signal integrity the ECU-Test signal loop has to be as short as possible. If longer than 250 mm this wiring has to be of screened and twisted pair type.

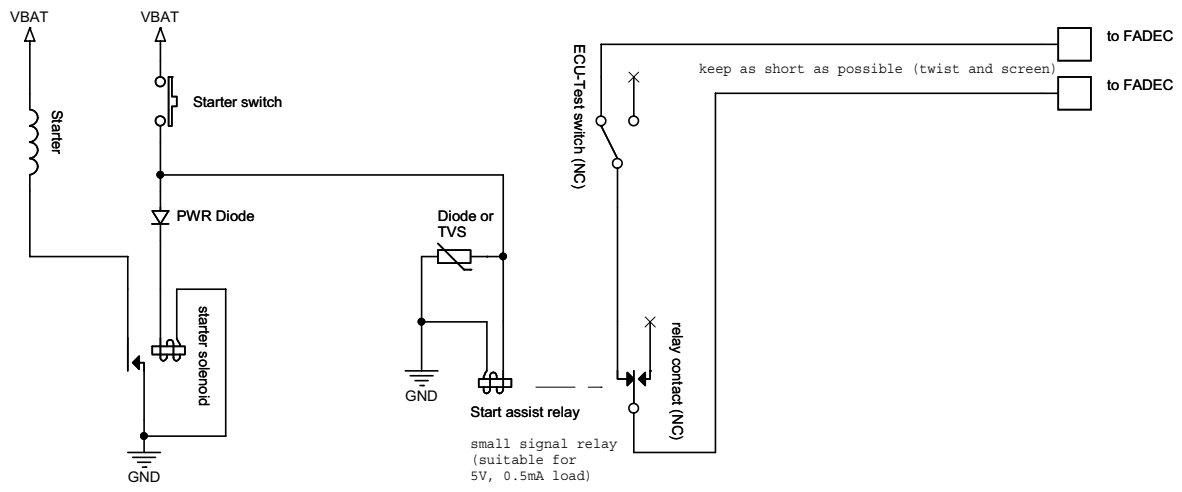

Fig. 13.2 installation principles: power diode

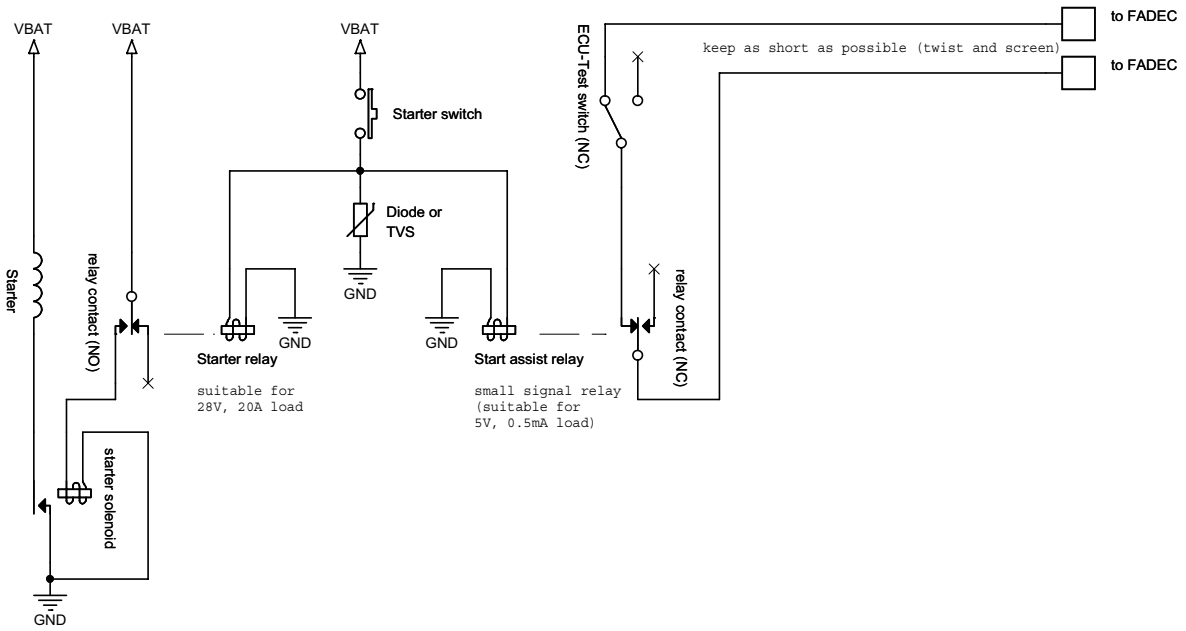

Fig. 13.3 installation principles: starter relay (recommended)

13.9 Instrument connections

◆ Note: The compliance for certification of the required individual instruments according to the applicable requirements like JAR or FAR has to be accomplished by the aircraft or airframe manufacturer.

◆ Note: Technify Motors GmbH offers an appropriate instrument panel (CED-125) under the order number 02-7730-5501-(xx)-(xx) which can be used to monitor all of the engine parameters. This display is certified in accordance with JTSO-C113 by the Luftfahrt-Bundesamt.

For installations with the GARMIN 1000 and later versions, the CAN data flow is defined in the specification CANSPEC 02-01 (Issue 5 or later issue).

13.9.1 CED-125 engine display instrument

The CED-125 engine display instrument receives its data from the CAN bus and displays the following readings:

- Propeller speed
- Load
- Oil pressure
- Oil temperature
- Coolant temperature
- Gearbox temperature

The TAE-CED125 engine display instrument with the part number 02-7730-5501-(xx)-(xx) was tested as follows in accordance with EUROCAE ED14D / RTCA DO160D:

Conditions	Section	Description of tests conducted
Temperature and Altitude	4.0	TAE-CED125 tested to Categories A2 and B2
Temperature Variation	5.0	TAE-CED125 tested to Category B
Humidity	6.0	TAE-CED125 tested to Category A
Operational Shock and Crash Safety	7.0	TAE-CED125 tested to Category B
Vibration	8.0	TAE-CED125 tested to Category S, test curve M
Explosion	9.0	TAE-CED125 identified as Category X, no test performed
Waterproofness	10.0	TAE-CED125 identified as Category X, no test performed
Fluids Susceptibility	11.0	Alternator identified as Category X, no test performed
Sand and Dust	12.0	TAE-CED125 identified as Category X, no test performed
Fungus	13.0	TAE-CED125 identified as Category X, no test performed

Conditions	Section	Description of tests conducted
Salt Spray	14.0	TAE-CED125 identified as Category X, no test performed
Magnetic Effect	15.0	TAE-CED125 tested to Category Z. The distance for a deflection of Dc is less than 0.3 m
Power Input	16.0	TAE-CED125 tested to Category B
Voltage Spike	17.0	TAE-CED125 tested to Category A
Audio Frequency Susceptibility	18.0	TAE-CED125 tested to Category B
Induced Signal Susceptibility	19.0	TAE-CED125 identified as Category X, no test performed
Radio Frequency Susceptibility	20.0	TAE-CED125 tested to Category V
Radio Frequency Emission	21.0	TAE-CED125 tested to Category B
Lightning Induced Transient Susceptibility	22.0	TAE-CED125 identified as Category X, no test performed
Lightning Direct Effects	23.0	TAE-CED125 identified as Category X, no test performed
Icing	24.0	TAE-CED125 identified as Category X, no test performed
Electrostatic Discharge	25.0	TAE-CED125 tested to Category A

13.10 Electromagnetic Compatibility and Environmental Testing Categories for the FADEC and Wiring Harness

13.10.1 FADEC D48 (P/N: 05-7611-K0001xx)

The FADEC and the wiring harness of the TAE-CED125 were tested as follows in accordance with EUROCAE ED14D / RTCA DO-160D, Section 4-25:

Environmental testplan as defined by EUROCAE ED-14D / RTCA DO-160D, Section 4-25

Conditions	Section	Description of tests conducted
Temperature and Altitude	4.0	Equipment tested to Category A2 and B2
Temperature Variation	5.0	Equipment tested to Category B
Humidity	6.0	Equipment tested to Category A
Operational Shocks and Crash Safety	7.0	Equipment tested to Category B
Vibration	8.0	Equipment tested to Category S, test curve M
Explosion Proofness	9.0	No test needed because of the FADEC mounting position in the cockpit
Waterproofness	10.0	FADEC identified as Category X, no test performed
Fluids Susceptibility	11.0	No test needed because of the FADEC mounting position in the cockpit
Sand and Dust	12.0	No test needed because of the FADEC mounting position in the cockpit
Fungus Resistance	13.0	No test needed because of the FADEC mounting position in the cockpit
Salt Spray	14.0	No test needed because of the FADEC mounting position in the cockpit
Magnetic Effect	15.0	Equipment tested to Category A
Power Input	16.0	Equipment tested to Category B Since a safe engine shut down is a minor effect on engine level, a reboot of the FADEC was allowed in this test.
Voltage Spike	17.0	Equipment tested to Category A
Audio frequency conducted susceptibility power inputs	18.0	Equipment tested to Category B
Induced Signal Susceptibility	19.0	This test is only needed if 110 V / 400 Hz power systems are used. TAE-125 is a small engine and will only be used in small aircraft that don't have such a power system.
Radio Frequency Susceptibility	20.0	Equipment tested to Category Y, W and R
Emission of radio frequency	21.0	Equipment tested to Category B
Lightning Induced Transient	22.0	Equipment tested to: Waveform Set A: Level 3 / Waveform Set E: Level 5
Direct Lightning Effects	23.0	No test needed, because of the mounting position.
Icing	24.0	No test needed because of the FADEC mounting position in the cockpit
Electrostatic Discharge (ESD)	25.0	Equipment tested to Category A

13.10.2 FADEC D4 (P/N: 05-7611-E0019xx)

The FADEC and the wiring harness of the TAE-CED125 were tested as follows in accordance with EUROCAE ED14F / RTCA DO-160F, Section 4-26:

Environmental testplan as defined by EUROCAE ED-14F / RTCA DO-160F, Section 4-26

Conditions	Section	Description of tests conducted
Temperature and Altitude	4.0	Equipment tested to Category B2
Temperature Variation	5.0	Equipment tested to Category B
Humidity	6.0	Equipment tested to Category A
Operational Shocks and Crash Safety	7.0	Equipment tested to Category B
Vibration	8.0	Equipment tested to Category S, test curve L/M
Explosion Proofness	9.0	No test needed because of the FADEC mounting position in the cockpit
Waterproofness	10.0	FADEC identified as Category X, no test performed
Fluids Susceptibility	11.0	No test needed because of the FADEC mounting position in the cockpit
Sand and Dust	12.0	No test needed because of the FADEC mounting position in the cockpit
Fungus Resistance	13.0	No test needed because of the FADEC mounting position in the cockpit
Salt Spray	14.0	No test needed because of the FADEC mounting position in the cockpit
Magnetic Effect	15.0	Equipment tested to Category A
Power Input	16.0	Equipment tested to Category B (XX)
Voltage Spike	17.0	Equipment tested to Category A
Audio frequency conducted susceptibility power inputs	18.0	Equipment tested to Category B
Induced Signal Susceptibility	19.0	Equipment tested to Category ZC
Radio Frequency Susceptibility	20.0	Equipment tested to Category Y and R
Emission of radio frequency	21.0	Equipment tested to Category B
Lightning Induced Transient Susceptibility	22.0	Equipment tested to: Waveform Set A: Level 3 Cable Bundle Tests (all screens removed, separate bundles) Multiple burst: W3: Level 3 Single stroke: done as part of multiple stroke Multiple stroke: W4: 300V/75V; W3 1200V/750V (engine loom) 600V/300V (CAN and supply lines)
Direct Lightning Effects	23.0	No test needed, because of the mounting position.
Icing	24.0	No test needed because of the FADEC mounting position in the cockpit
Electrostatic Discharge (ESD)	25.0	Equipment tested to Category A
Fire Flammability	26.0	No test needed because of ECU mounting position in the cockpit / similarly protected area.

13.11 Lightning Protection

The FADEC of the CD-135 and CD-155 is protected against the effects of indirect lightning strike. In order to protect the aircraft from the effects of a direct lightning strike at the propeller, it is necessary to offer the lightning current a path of low impedance from the engine to the aircraft skin.

The following measures must be implemented or taken into consideration during installation:

- As the engine is mounted on vibration dampers made of rubber, all three bearings must be bridged with a grounding strap which should be as short as possible and have a sufficiently large cross-section and low impedance.
- To prevent the flow of larger currents through the wiring harness, a grounding strap which should be as short as possible should be routed from the engine to the firewall. This grounding strap must be tightly strapped to the wiring harness. All grounding straps of the engine control system are integral part of the engine wiring harness.
- Ground straps between the engine and its mount shall not be longer than 220 mm.
- The battery should be mounted directly on the firewall. If this is not possible, the battery lines should be routed in parallel, and the negative line of the battery should also be additionally grounded on the firewall.
- If the battery is not mounted directly at the firewall, it should also be checked whether the inputs of the FADEC should also be additionally protected with two varistors.
- Relays in the electrical system of the aircraft which are equipped with diodes for the suppression of over-voltages must be checked for their behavior under lightning strike. These diodes may short-circuit under a lightning strike, thus preventing the relay from functioning. Therefore, the diodes should be removed from all critical relays, or such critical relays should be equipped with a fuse which is connected in series.

13.12 Check List for Acceptance Inspection of the Installation

Testing the electric circuits	OK
All live lines are protected with a fuse or circuit breaker close to the voltage supply.	
The wire cross-sections (AWG) are also noted in the circuit.	
The fuse protection match the wire dimensions - all fuses must actuate before the line capacity is reached.	
In the event of a loss of power from the battery, continued supply to the FADEC is provided by the alternator.	
The transition from the actual electrical system of the engine to the electrical system of the aircraft is implemented at just a few protected transition points.	
The electrical system of the engine and the electrical system of the aircraft can be isolated from each other.	
The FADEC is supplied with a minimum of 15 A.	
The excitation battery can be switched off.	
A charge current failure warning system is present.	
Switches, relays and the battery all have sufficient capacity.	
The Main switch isolates the battery and the electrical system of the aircraft from the electrical system of the engine.	

Checking the installation	OK
Wires and wiring harnesses are securely routed and do not chafe anywhere (cowling, engine frame, belts and other components of the engine).	
All wires have enough clearance to take any movements of the engine. Test: Manually move the engine around and observe the cables.	
The MAP connections are compression-proof to 5 bar. The MAP Connections are protected from condensed water.	
On the pressure connections to the ambient pressure, the probability of malfunctions arising due to the ingress of contaminants or icing must be minimized (filter or connection to aircraft static port system).	
All connections and pipes are protected against being constricted or kinked.	
Compliance of the display lamp colors (FADEC warning A/B:, Glow Master Caution, failure warning lamp AWL) with JAR 23.1322?	
Are the bonding grounding straps for lightning protection existent?	
Have all other lightning protection measures been implemented?	
Is the diagnostic connector fitted with a CAN terminator?	

Functional test	OK
Check Start phase monitoring. Start info relay actuates while starter button is pressed.	
Battery main switch / battery relay	
Engine Master	
FADEC test switches, warning lamps and FADEC A/B switch.	
Load selection lever in the range 0 .. 100 %	
Glow relay + glow lamp	
All switches and lamps are displayed in the panel.	
Check all circuit breakers for correct operation.	
Check all electrical consumers for correct operation.	
Diagnostic connector protected with a terminating connector	
Behavior of the control elements confirms agreement with circuitry	
The engine must continue running on alternator voltage when the main switch is switched off.	

Date:

Acceptance issued:

_____
Signature of tester

This page intentionally left blank

14 Propeller Drive

14.1 General

◆ Note: Applicability of the components from the aircraft manufacturer shall be made sure in accordance with JAR 23, FAR 23 and CS 23.

14.2 Technical Data for the Propeller Flange

Direction of rotation of the propeller flange: ..... clockwise, refer to Chapter 3, Section 3.4, Page 2 of this Manual

Position: ..... in the coordinate center

Propeller shaft flange connection: .. only use bolts recommended by the propeller manufacturer

Hole circle: ..... 80 mm

Straightway bore: ..... 6 bores, 11.4 mm

Gear reduction: ..... i = 1.69 (3880 RPM engine = 2300 RPM prop)

Max. torque on the propeller shaft: ..... 473 Nm

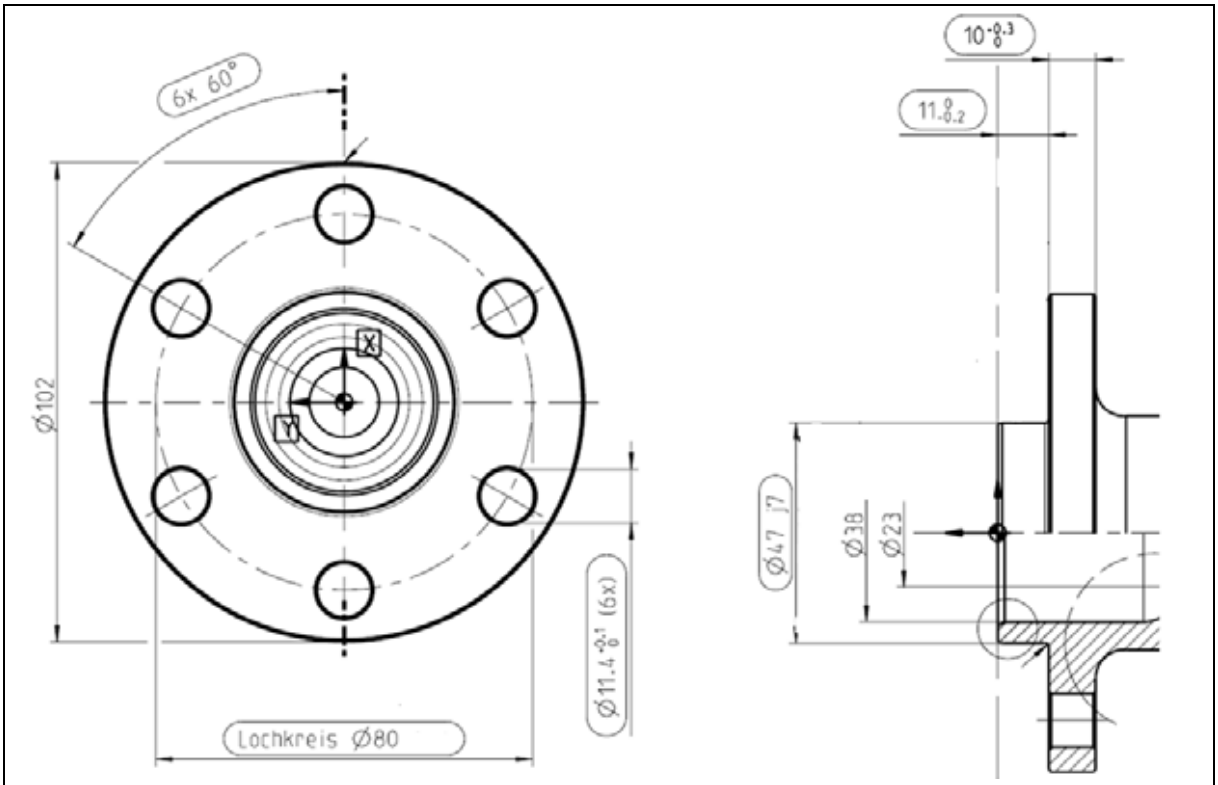

Fig. 14.1 Propeller shaft flange [mm]

14.3 Propeller

14.3.1 Installation Information

▲ **WARNING:** The propeller must NOT be mounted directly onto the crankshaft.

- The propeller must be mounted on the propeller flange according to the regulations in the Installation Manual of the propeller manufacturer.
- **Tightening torque** of the stop nuts 7/16" UNF for the propellers MTV-6-A-(1*)/(2**)-(3***)-(4****):
  in accordance with MT-Manual

14.3.2 Propeller Limitations

▲ **WARNING:** The suitability of the engine for a particular propeller-aircraft combination has to be proofed as part of the type certification of the aircraft.

Propeller diameter:

Minimum diameter ..... not limited
Maximum diameter ..... 1900 mm

Moment of inertia:

Minimum moment of inertia ..... not limited
Maximum moment of inertia 0,89kgm²

Propeller weight:

Minimum propeller weight ..... not limited
Maximum propeller weight 19kg

Hub extension, distance from gearbox flange to blade center:

Minimum distance ..... not limited
Maximum distance ..... 184 mm

Propeller flange:

Propeller flange ..... A-Type
(See 14.2 Technical Data for the Propeller Flange)

Propeller control system:

Propeller controller .....PC_CSU: 05-7212-K0304xx
with
valve: 05-7212-E0028xx (28V)
or
05-7212-E0014xx (14V)
may only be used

Software .....Standard certified and released
FADEC software may only be used.

◆ Note: See service bulletin for latest released software versions (contact Technify Motors GmbH for any questions).

Propeller oil pressure:

Minimum oil pressure in propeller control system .....0 bar

Maximum oil pressure in propeller control system during operation
(Gearboxes without Oil/Water Heat Exchanger) .....21 bar
(Gearboxes with Oil/Water Heat Exchanger) .....22 bar

Propeller need to resist pressures up to .....25 bar

◆ Note: The actual oil pressure in the propeller control depend on the operation conditions (delta between target and actual RPM, aircraft speed, propeller type). It is a close loop controlled system, controlled by the propeller control regulator.

▲ **WARNING:** Only the following propellers are suitable for this engine:
MTV-6-A-(1*)/(2**)-(3***)-(4****)

max. diameter of the propeller is limited to: .....1900 mm
the moment of inertia may not exceed: .....0,89 kgm²

◆ Note: Decoding shown in the following table:

MTV-6-A-(1*)/(2**)-(3***)-(4****)	
(1*)	Feather provision (Hub): - blank = no feather position possible - C - F = counterweights for pitch change forces to increase pitch and feather position possible
(2**)	Position of pitch change pin: - blank = pin position for pitch change forces to decrease pitch (Constant Speed) - CF (Constant Speed & Feather) pin position to allow feather, pitch change forces to increase pitch
(3***)	Propeller Diameter: - Propeller diameter from 175 cm to 190 cm
(4****)	Identification of blade design: - 69 - 80 - 129

Example: MTV-6-A/187-129	
(1*)	Feather provision (Hub): - blank = no feather position possible
(2**)	Position of pitch change pin: - blank = pin position for pitch change forces to decrease pitch (Constant Speed)
(3***)	Propeller Diameter: - Propeller diameter 187 cm
(4****)	Identification of blade design: - 129

14.3.3 Propeller control

The FADEC controls the target speed for the propeller. The target speed is based throttle input. For take off, the desired speed is 2300PRM. For normal cruise conditions, the speed is between 1800 and 2150 RPM, depending on the throttle setting. In case the engine producing less power that needed for achieving the target speed, the propeller will remain in a low pitch position.

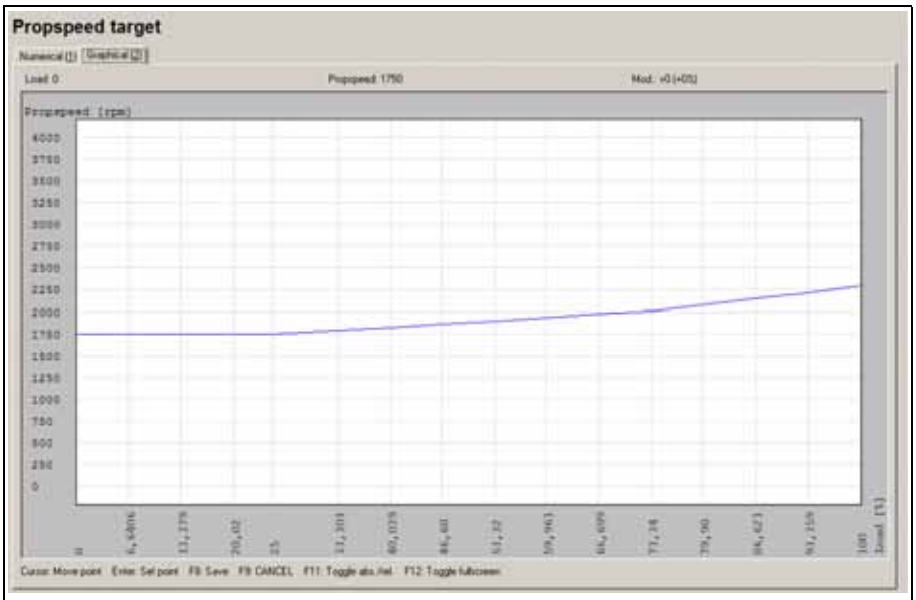

Fig. 14.2 Propspeed target diagram

Due to the integrated propeller control in the FADEC, an automatic overspeed control is active.

In addition, please review CSUM-02-02 manual for additional details.

The Centurion engines can only be operated by using the integrated propeller control system. Therefore, it is essential that the propeller functions properly with the Technify Motor GmbH Regulator (PC_CSU).
Normal or inverted propeller can be used. Based on the propeller design (twin or single application), different regulator software can be supported.

- High pressure for high pitch (single engine application)
- High pressure for low pitch (twin engine application)

◆ Note: Please review certified software for specific application!

14.3.4 Basic testing requirements

The propeller supplier shall show compliance in addition to all CS-P requirements.

14.3.5 Flight, operation verification

Ground run:

At maximum power at the ground (with no wind influence), the propeller speed need to be between 2250 and 2300 RPM.

FADEC Test:

The automatic FADEC is also verifying the propeller control system since it is an integrated propeller control system.

The FADEC and propeller pitch functional check must be conducted as described in Operation Manual OM-02-02. In addition to Operation Manual the propeller speed targets for each step in the functional check must be reached. After the test a recovery time of maximum 10 seconds. The FADEC and propeller pitch functional check must be accomplishable with gearbox oil temperatures higher than 35°C.

Flight behavior stable throttle input:

- Under all, constant flight conditions, the RPM need to regulate within ±20RPM the target speed
- Larger oscillation or undamped behavior may not occur at any time

This need to be proven over the complete speed and altitude range with multiple power settings from idle to full power (40-50-60-70-80-90-100% throttle command) and up to maximum certified altitude.

Flight behavior dynamic with variable throttle settings

TASK 1: Overspeed behavior with propeller control active need to be verified and within the limits of the OM-02-02.
TASK 2: Overspeed behavior without propeller control active need to be proven and within the limits of the OM-02-02.
TASK 3: Step response need to be proven and the result shall be within the defined limits in Fig. 14.3 and Table 14.1.

This verification need to be done at low, medium and maximum certified altitude, for example 2000, 10000 and 18000ft AND with 3 different aircraft speed spread over the speed envelope of the aircraft (for example 70 - 120 - 150KIAS).

- Power up steps to be verified at each altitude and aircraft speed

Start step % throttle command	Stop step % throttle command
0	100
50	100
75	100
90	100
0	50
0	75
50	75
75	100

- Power down steps to be verified at each altitude and aircraft speed

Start step % throttle command	Stop step % throttle command
100	0
100	50
100	75
100	90
75	0
75	50

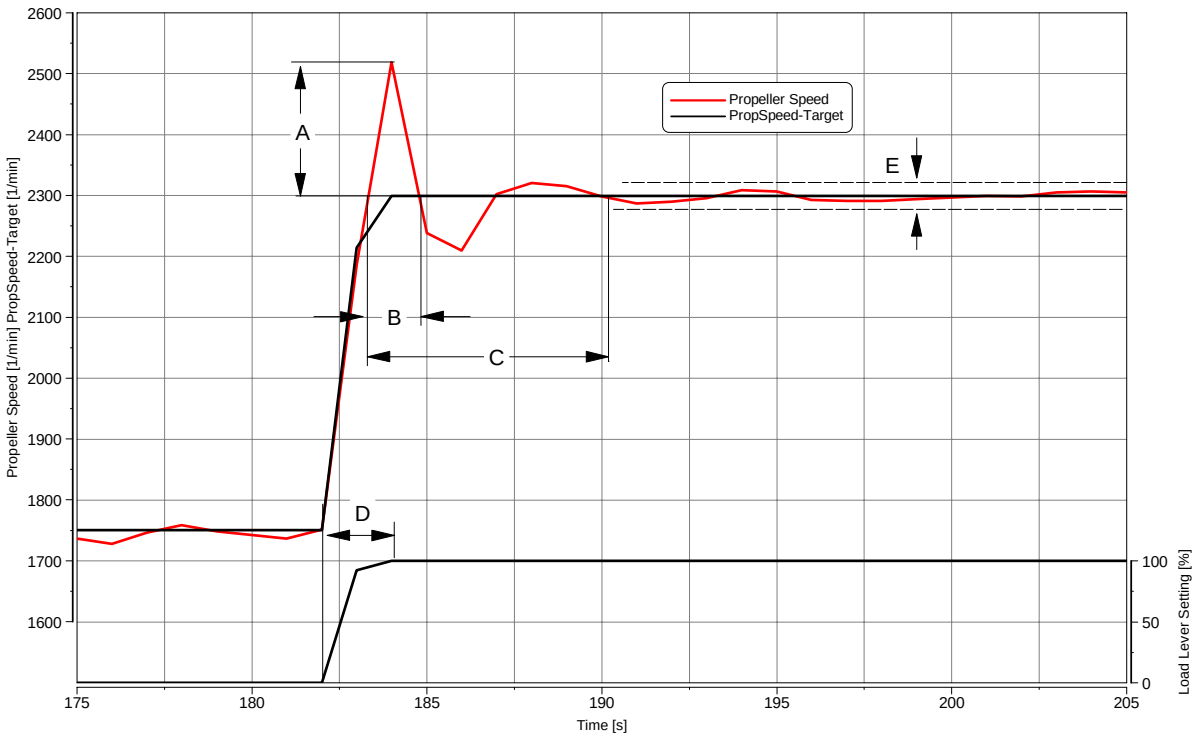

Fig. 14.3 Definition overshoot behavior

Air Speed	A	B	C	D	E
Vs-100KIAS	150RPM	2 sec	5 sec	< 1 sec	±20RPM
100-150KIAS	200RPM	2 sec	5 sec	< 1 sec	±20RPM
150KIAS- Vne	200RPM	2 sec	5 sec	< 1 sec	±20RPM

Table 14.1 Definition overshoot behavior

High speed decent test

Propeller Control behavior from Vs up to Vne with 100% Load setting, the RPM to regulate within ±20RPM of the target speed. This need to be verified at high and medium altitude within the envelope of the certified aircraft. (Caution for potential flutter of aircraft at high speed and high altitude)

Idle decent behavior

- No oscillation may occur
- Propeller shall / will behave as a fix pitch propeller under those conditions
- Engine running condition need to be verified. No engine flame out may occur due to too low RPM.
- Minimum allowed RPM during this condition may not be less than 1000RPM.

Go-around behavior at different altitudes

Same requirements as with specified Flight dynamic behavior. This need to be verified at low and medium altitudes (up to 12000ft).

14.4 Constant Speed Unit

On the constant speed unit, must be set a primary pressure of

- 20 bar (290 psi)
  for Gearboxes without Oil/Water Heat Exchanger
  (refer to RM-02-02 Chapter 72-10.05)
- 21 bar (305 psi)
  for Gearboxes with Oil/Water Heat Exchanger (Laminova)
  (refer to RM-02-02 Chapter 72-10.16)

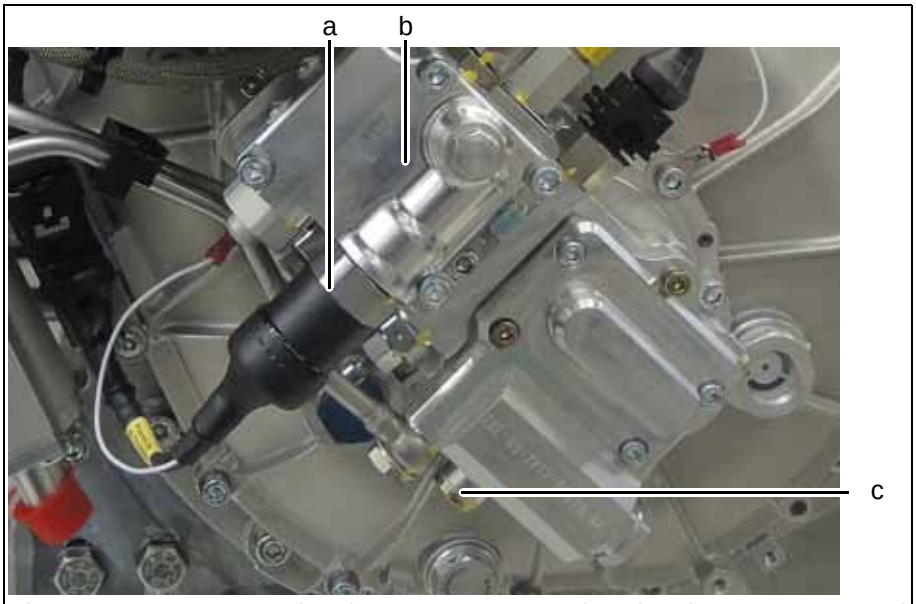

Fig. 14.4 Connecting the pressure gauge / setting the constant speed unit

a Pre-pressure regulator
b constant speed unit (CSU)
c Screw plug of single stage pump

15 Vacuum Pump

◆ Note: The CD-155 engine is available with or without vacuum pump.

15.1 General

◆ Note: Applicability of the components from the aircraft manufacturer shall be made sure in accordance with JAR 23, FAR 23 and CS 23.

For the vacuum system: hoses suitable for the use in vacuum systems must be used, hose clamps and a reducer have to be provided, since they are not included in the scope of supply of the engine.

15.2 Technical Data for the Vacuum Pump

Max. possible suction: ..... 150 mbar relative
Max. output: ..... 160 l/min at 2300 rpm (propeller speed)

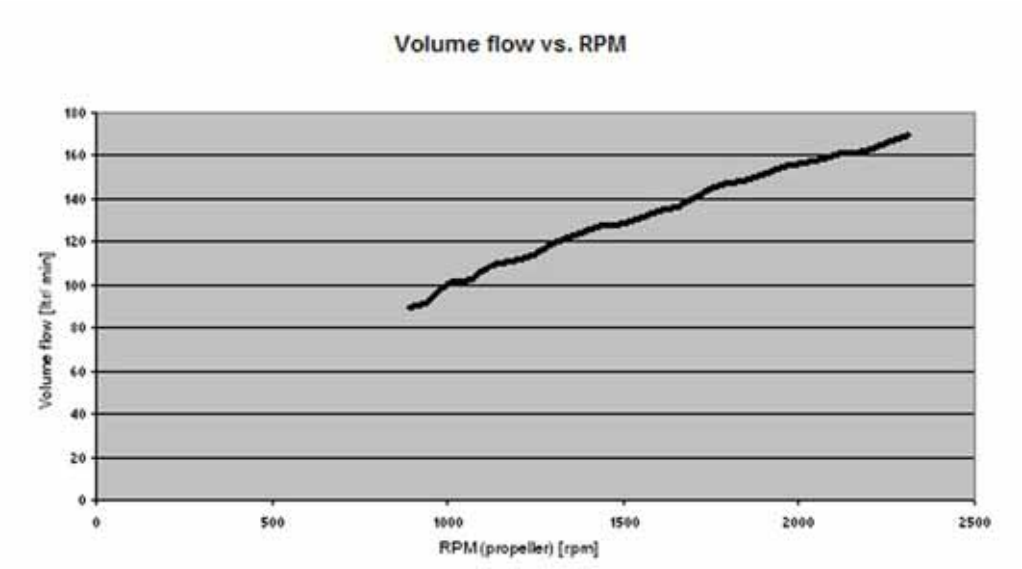

Fig. 15.1 Volume flow diagram

◆ Note: The vacuum system is influencing the oil consumption. The less vaccum flow is required, the lower the oil consumption.

15.3 Connection and Connection Locations

The vacuum pump is located on the cylinder head on the belt side of the engine (refer to Fig. 15.2).
The vacuum regulation valve of the aircraft should be connected with an appropriate, vacuum-proofed hose to the tube of the vacuum pump. Additionally, in the line between engine and connection of the vacuum system of the aircraft, a reducer has to be provided.

Tube dimension:.....10 mm tube diameter

Hose dimension: ..... 10 mm inside diameter

Restrictor:..... 2.8 mm to 3.5 mm inside diameter
(depending on the equipment of the relevant aircraft)

Fig. 15.2 Vacuum pump connections

The hose should be fastened with clamps to the tube of the vacuum pump and to the connection to the vacuum system of the aircraft, that leaks are prevented. Only standardized and appropriate hoses and clamps must be used. It is recommended to fasten each end of the hose with two hose clamps each.
We recommend that every pipe end be fastened with two pipe clamps.

▲ **WARNING:** In the event of any leaks, the instruments controlled by vacuum may give incorrect readings.
Make sure utmost cleanliness during installation. Check the installation for leaks before taking it into operation.

■ CAUTION:	Remove the sealing cap on the tube drain of the vacuum pump before fastening the hose.

■ CAUTION:	Only standardized lines and connections must be used.

■ CAUTION:	For the vacuum system, a commercially available filter must be used on the airframe side.

■ CAUTION:	The vacuum pump is maintenance-free and only requires a visual inspection.

This page intentionally left blank