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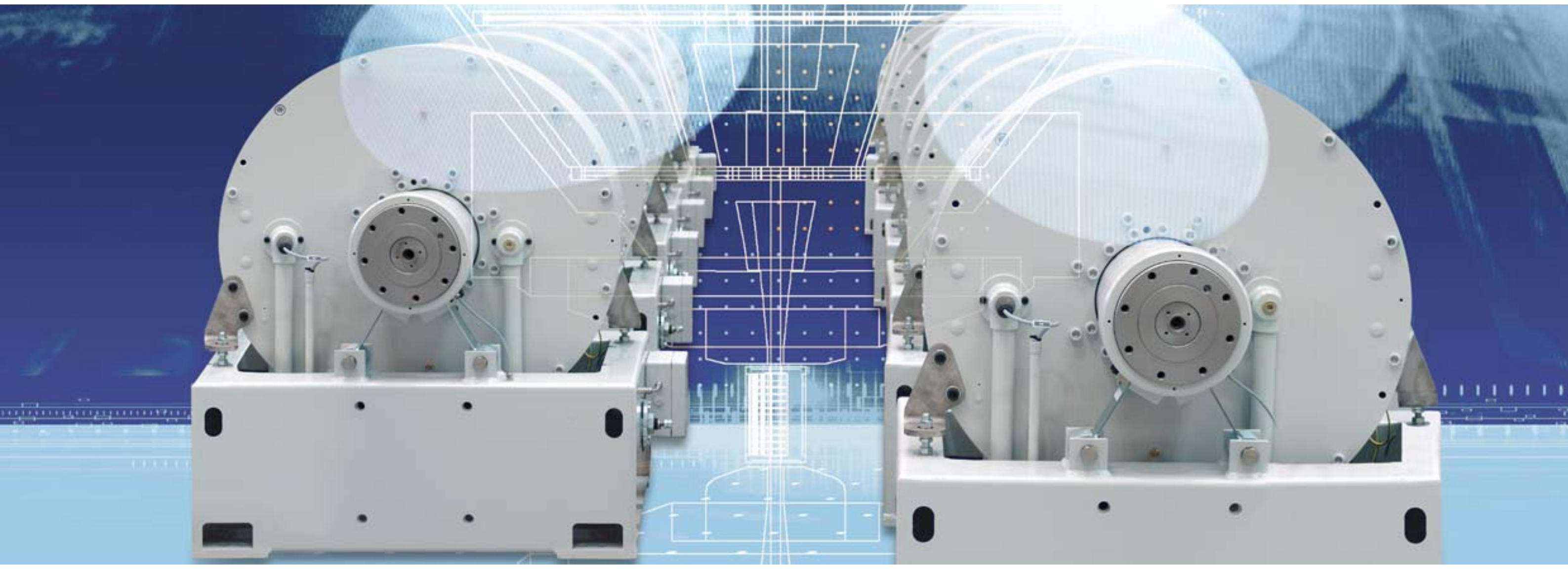

Eddy-Current Dynamometer Type WT

Technical Specification

Version/Date: 7.0 / 2008-03-01

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1 A HORIBA Product with Convincing Features

Fig. 1: Eddy-Current Dynamometer type WT

1.1 Fields of Application

In engine testing, eddy-current dynamometers are used as load units for the test specimen. The WT series eddy-current dynamometers are especially used for

- Development and testing of all kinds of power engines
- Quality control, running-in and endurance testing of combustion engines
- Developing and testing engine components such as pistons, valves, gaskets, filters, injection systems and ignition systems, exhaust systems and catalytic converters
- Fuel and lubricating oil tests with engines

Excellent control characteristics are achieved by combining test stand controllers and power units from HORIBA ATS. In case dynamic testing with additional actuation is required, eddy-current dynamometer and asynchronous machine can be combined as “tandem dynamometer”.

1.2 Multi-Purpose and Flexible in Design

As standard, the WT series dynamometers are designed cradle-mounted with patented HORIBA ATS flexure strips. For special applications, the cradle-mounted housing can also be supplied with trunnion bearings. With a second flange, loads can be coupled on both sides. With the starter system available as accessory, the engine does not need starter of its own. As power supply unit, the newly developed LEW 2002 is available.

1.3 Your Advantages

The WT series dynamometers stands out for the following features:

- High speeds for testing passenger cars engines, particularly petrol engines
- High torques at very low speeds for commercial vehicle engines, also for charged diesel engines
- Large couple able masses allowing the use of several connecting shafts
- Suitable for two rotating directions
- High measuring accuracy due to contact-free speed measurement via pulse generator as well as torque measurement via load cell
- Robust design, which integrates load cell inside the frame
- Long life time circle resulting from new mechanical design of cooling chambers and water pipe, thus high availability
- Easy maintenance due to optimized mechanical design
- Very easy to maintain and to repair, simple and low-cost assembly
- Cooling chambers and coil can be changed without dismantling bearings
- Simple rotor adjustment and setting of bearing clearance
- Prepared for on-site vibration monitoring of the bearings (drilling for vibration sensors)
- Optimized spare part handling due to use of many identical parts
- Storage of almost all sizes in standard version (flexure supports), thus fast delivery times

2 How it Works

2.1 Total Concept

The test specimen, generally a combustion engine, drives the dynamometer. The dynamometer absorbs the power and transforms it into heat energy. The test stand controller SPARC ensures the variables speed and torque are observed in that it controls one variable with the brake and the other with the test specimen.

2.2 Functional Principle

In an eddy-current dynamometer, the coil excites a magnetic field through one cooling chamber, the air gap with toothed rotor and the second cooling chamber. The magnetic flux lines close above the iron back. When the rotor rotates, the teeth continually rotate. This causes variation in the air gap. The variation of the air gap continually changes the magnetic circuit and, by that, the magnetic field of the cooling chamber. The varying magnetic field induces eddy currents at the narrow ends of the cooling chambers which are directed such that the magnetic field they generate produces a torque in the opposite direction to the direction of rotation of the rotor. The eddy currents generate heat in the cooling chambers which is dissipated through the cooling water.

The counter-torque increases at constant excitation with dynamometer speed.

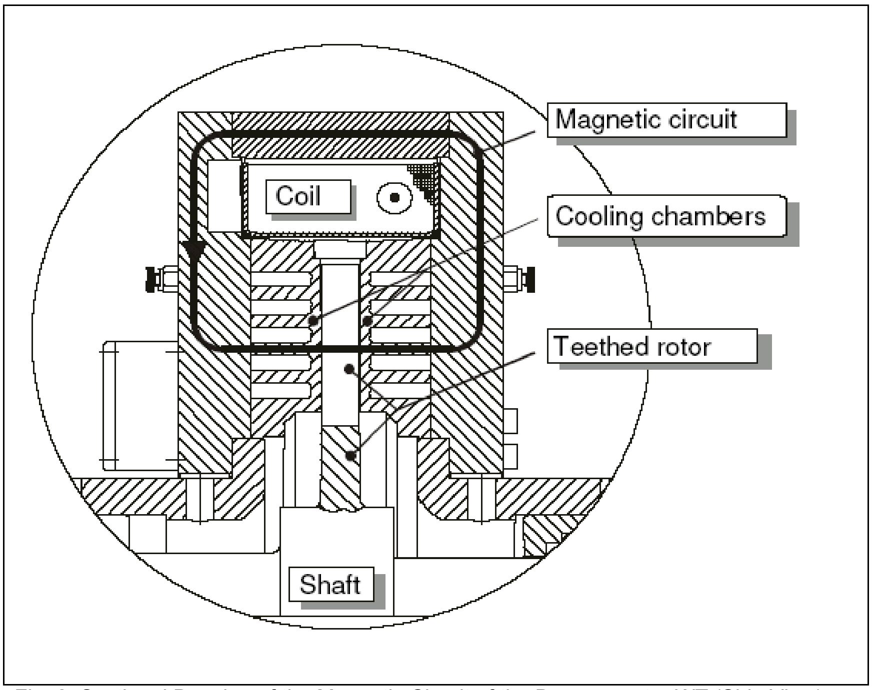

Fig. 2: Sectional Drawing of the Magnetic Circuit of the Dynamometer WT (Side View)

2.3 Torque Acquisition

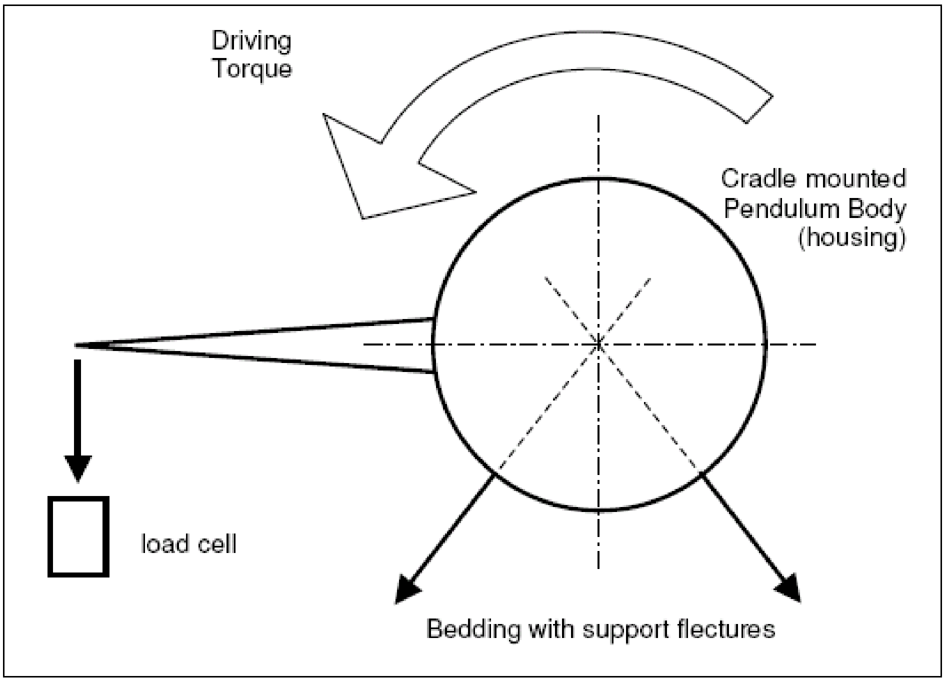

Fig. 3: Principle of Torque Measurement for Cradle-Mounted Housing

The test specimen is connected to the dynamometer rotor through a shaft and the flange. With the braking effect, the magnetic field transfers the torque to the stationary pendulum body. This pendulum body is suspended in such a way that it only permits small pendulum movements about its longitudinal axis. The special flexure support of the dynamometer only takes up the weight of the pendulum body and the counterforce to the load cell. Thus the total torque is effective via a lever arm on the load cell installed by the side of the pendulum body. The measured force is thus proportional to the braking torque. The flexure strips themselves are friction and maintenance-free to a large extent. The provide a quick response, allow almost hysteresis-free measurement of the torque and keep these features permanently.

2.4 Speed Acquisition

The speed is acquired digitally through a toothed wheel and an impulse sensor at the dynamometer shaft.

2.5 Frame

The dynamometer is on a sturdy welded frame. The frame also integrates cooling water inlet and outlet, the load cell for the torque measurement as well as the terminal box for connection to the electrical cables.

2.6 Power Supply Unit

The power component supplies the eddy-current dynamometer with the excitation current required for its operation. The new LEW2002 Power Component has been optimally matched for operation with the WT Dynamometer. It works with a fully controlled thyristor bridge. The two-quadrant operation that is thereby made possible also qualifies WT dynamometers for dynamic tests, in that the magnetic field can be built up quickly through the application of a positive voltage and removed again quickly too by reversing the voltage. The command value presetting for the excitation current comes from the test stand controller. The current regulator built into the power component ensures that the command value is quickly set and is even maintained during temperature changes in the dynamometer. An adjustable current limiter protects the excitation coil from overload. Furthermore, the power component is also equipped with an engine emergency-off relay.

Fig. 4: Power Supply Unit LEW 2002

2.7 Control Functions

As standard, eddy-current dynamometers with closed cooling circuit are equipped with a flow control unit and thermal switches in the water outlet. By that, damages due to insufficient cooling are avoided to a great extent. The flow control unit controls a minimal amount of cooling water and the thermal switches a maximally permissible cooling water outlet temperature. Both signals must be integrated in the safety circuit of the test stand so that a switch-off in case of unacceptable conditions is possible.

2.8 Test Stand Controller *SPARC*

The digital test stand controller SPARC (not included) from HORIBA ATS ensures the speed and the required torque are controlled. The unit has been optimally matched to operation with the dynamometer's power unit. Further information can be found in the respective technical specifications.

Fig. 5: Digital Test Stand Controller *SPARC*

2.9 Interfaces

Interface **1** - Mechanical Connections of the Eddy-Current Dynamometer

Master gauge for wholes of the coupling flange	Dimensions and drawing see chapter "Dimensions"
Dimensions of the dynamometer	Drawings see chapter "Dimensions"

Interface **2** - Torque signal form load cell, prepared for measurement with 6-wire technology

Nominal range supply voltage	0…10 V
Input resistance at reference temperature	350 ±2 W
Output resistance at reference tempera-ture	350 ±1,5 W

Interface **3** - Speed Signal

Pulse generator	60 pulses/revolution
Distribution voltage	12…24 V
Power consumption	< 50 mA

Interface **4** - Failure Message Dynamometer, Flow Control Unit and Two Tem-perature Sensors

Loading capacity of the contact	24 V / 100 mA

Interface **5** - Exciting Current Dynamometer

Output voltage	- 150 ... +170 V (fully controlled thyristor bridge)
Output current LEW 2002	0 ... 20 A
Maximum exciting current dynamometer	See chart chapter "Eddy-Current Dy-namometer"

Interface **6** - Internal Control Signals

Command value current, analogue input	Voltage range 0 – 10 V
Switch-on signal	24 V DC, power consumption < 100 mA
Release signal	24 V DC, power consumption < 10 mA
Failure power supply unit, temperature monitoring	24 V DC, closed in normal operation (at 0 V)

Interface **7** - Power Supply Test Stand Controller and Power Supply Unit

Power supply	1 ~ PEN, 230 V, 50/60 Hz

Interface **8** - Test Stand Controller / Test Stand Level

Superset automation	RS 232, CAN, Ethernet
Safety monitoring	Emergency-stop, safety circuit
Further interfaces	See technical specification *SPARC*

Interface **9** - Signals Specimen (optional)

Second speed signal for shaft breaking monitoring, pulse generator	60 pulses/revolution
Engine switch-off	Potential-free relay contact

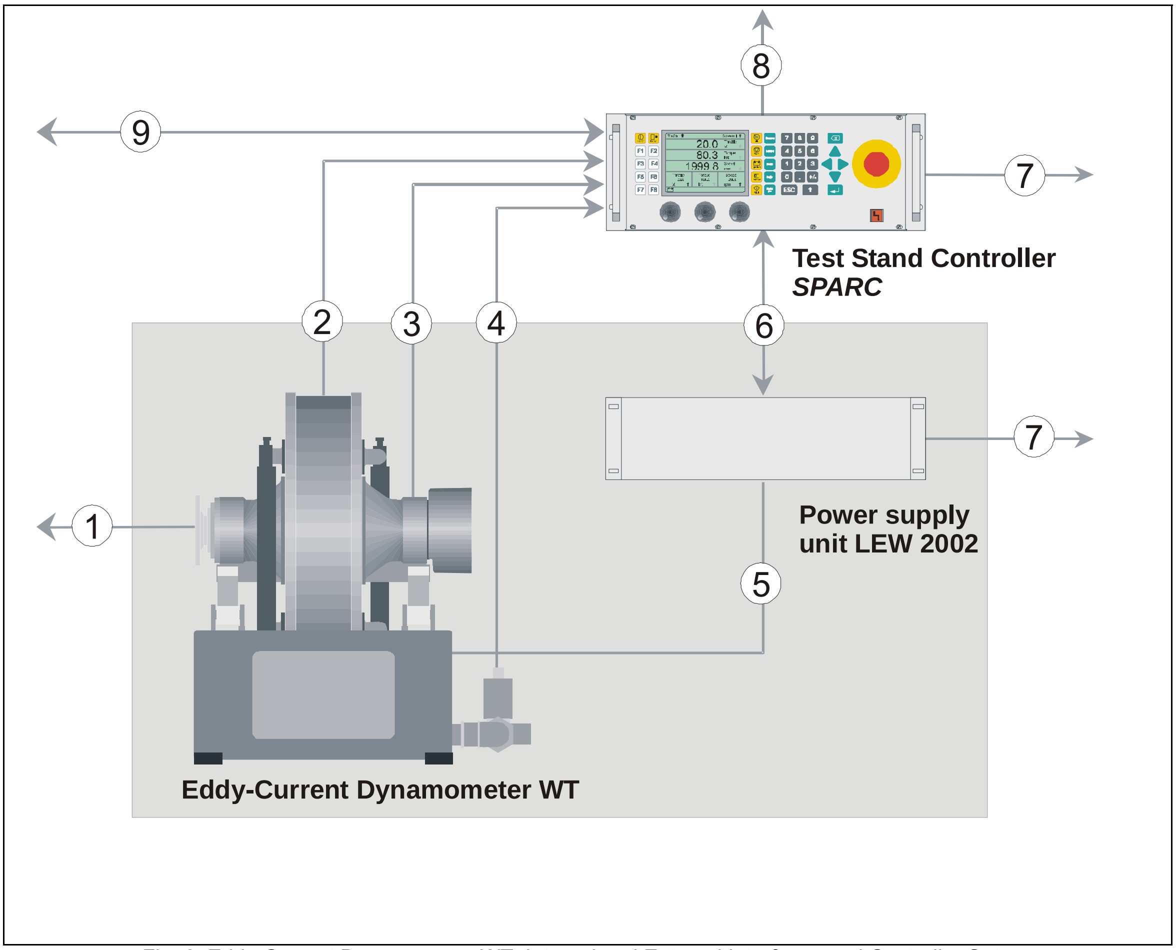

Fig. 6: Eddy-Current Dynamometer WT, Internal and External Interfaces and Controller Set

3 What we Deliver

The following is included in the basic scope of supply

The Eddy-current dynamometer including:

- Pendulum body
- Pendulum bearing with flexure strips
- Pulse generator for speed measurement
- Load cell for torque measurement
- Cooling temperature monitoring
- Water flow monitoring
- Frame

Power Supply unit

- 19“-plug-in unit LEW 2002
- Cable set
- Technical documentation

Options

Further assemblies and services can be ordered in addition to the standard extent of supply.

4 Figures, Data, Facts

4.1 Type Key

The eddy-current dynamometer of the new HORIBA ATS GmbH series is characterised by the initials “WT”:

WT S x – xxx

- Rated power in kW
- Rotor key if it is not a one-rotor type
- High-speed dyno
- Eddy-current dynamometer

4.2 Eddy-current dynamometer

		WT190	WT2-380	WT300	WT2-600	WT470	WTS470
Power	kW	190	380	300	600	470	470
Rated torque	N*m	600	1200	1200	2000	3000	2400
Minimal speed for rated torque	rpm	1700	2000	1000	1500	750	1000
Maximal speed	rpm	10000	9000	7500	8000	4000	7000
Mini. speed for maximal power	rpm	3030	3030	2390	2870	1500	1870
Moment of inertia	kg*m²	0,17	0,35	0,49	0,97	1,96	2,06
Torsion spring stiffness to dyno centre	10^6 N*m/rad	0,3	0,3	0,5	0,6	1,8	1,8
Maximal share of mass to be coupled at n_{max} at distance from coupling flange	kg	4,6 of 80 mm 4,1 of 90 mm	4,3 of 80 mm 3,9 of 90 mm	10,2 of 80 mm 9,2 of 90 mm	8,5 of 80 mm 7,9 of 90 mm	42,6 of 90 mm 34,3 of 120 mm	24,5 of 90 mm 18,5 of 120 mm
Maximum exciting current	A	10					
Weight	kg	350	680	670	1130	1350	1350
Colour		Light-grey RAL 7035					
Operating temperature	°C	0…+60 without cooling water addition					
		–25…+60 with antifreezer with antifreeze and power reduction in line with the drop in heat capacity of the coolant					
Transporting and storage temp.	°C	-50…+85					
Cooling water supply	m³/h	see chapter "Cooling Water Supply"					
Torque / Speed Measuring System							
Measuring accuracy speed	rpm	± 1, not lower than 0,025 % of rating					
Measuring accuracy torque	%	Accuracy class 0,2 (related to the measuring range final value), that means hysteresis error < 0,2, linearity error <0,2 temperature drift < 0,2 per 10 K change of the ambient temperature					
Control accuracy speed *	rpm	± 3					
Control accuracy torque*	%	± 0,6 , referring to rating					

* referring to the system eddy-current dyno, power supply unit, test stand controller

4.3 Power Ranges

4.3.1 One-rotor Eddy-current dynamometer

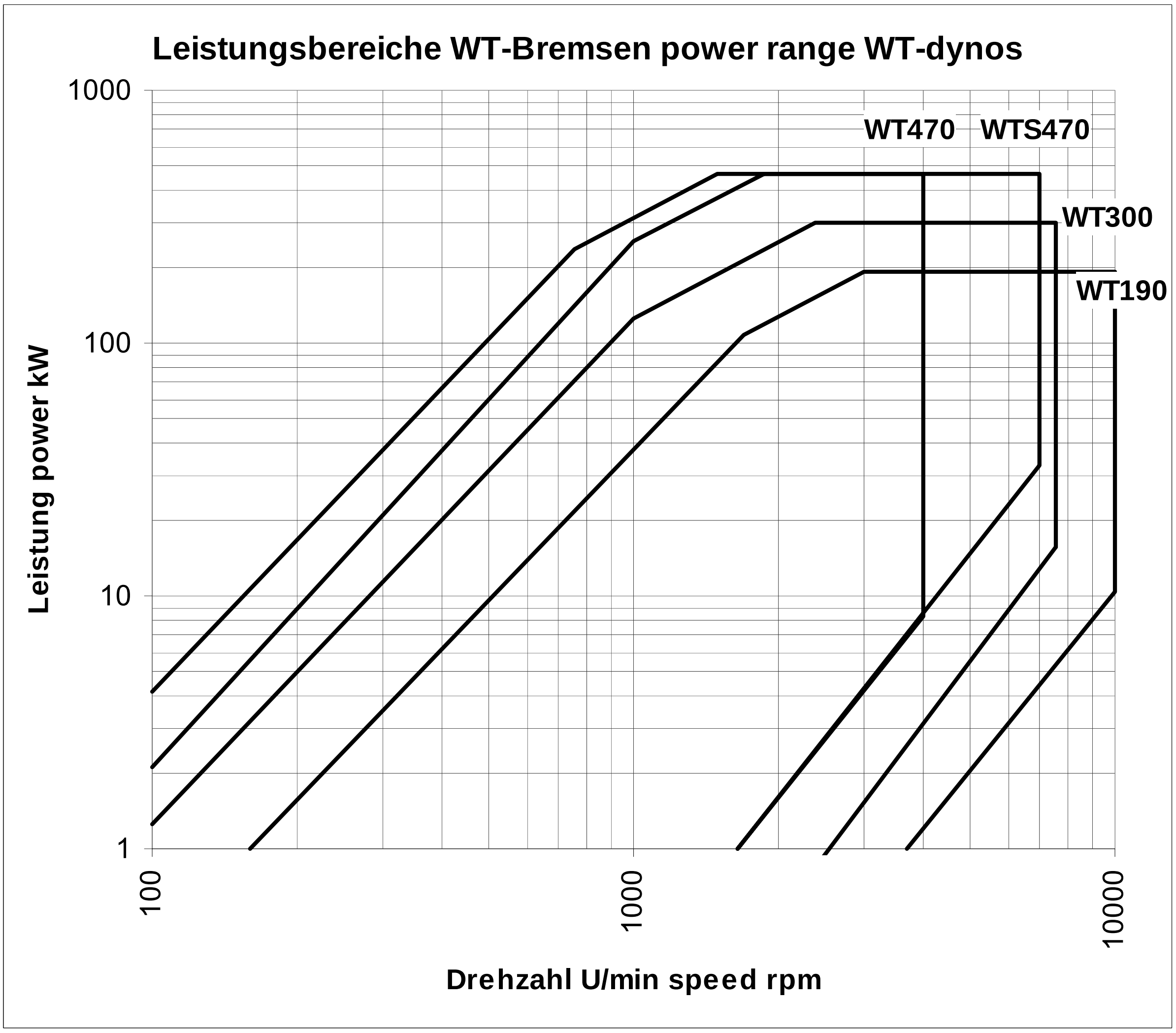

Fig. 7: Power Diagram of Eddy Current Dynamometers type WT

4.3.2 Two-rotor eddy current dynamometer

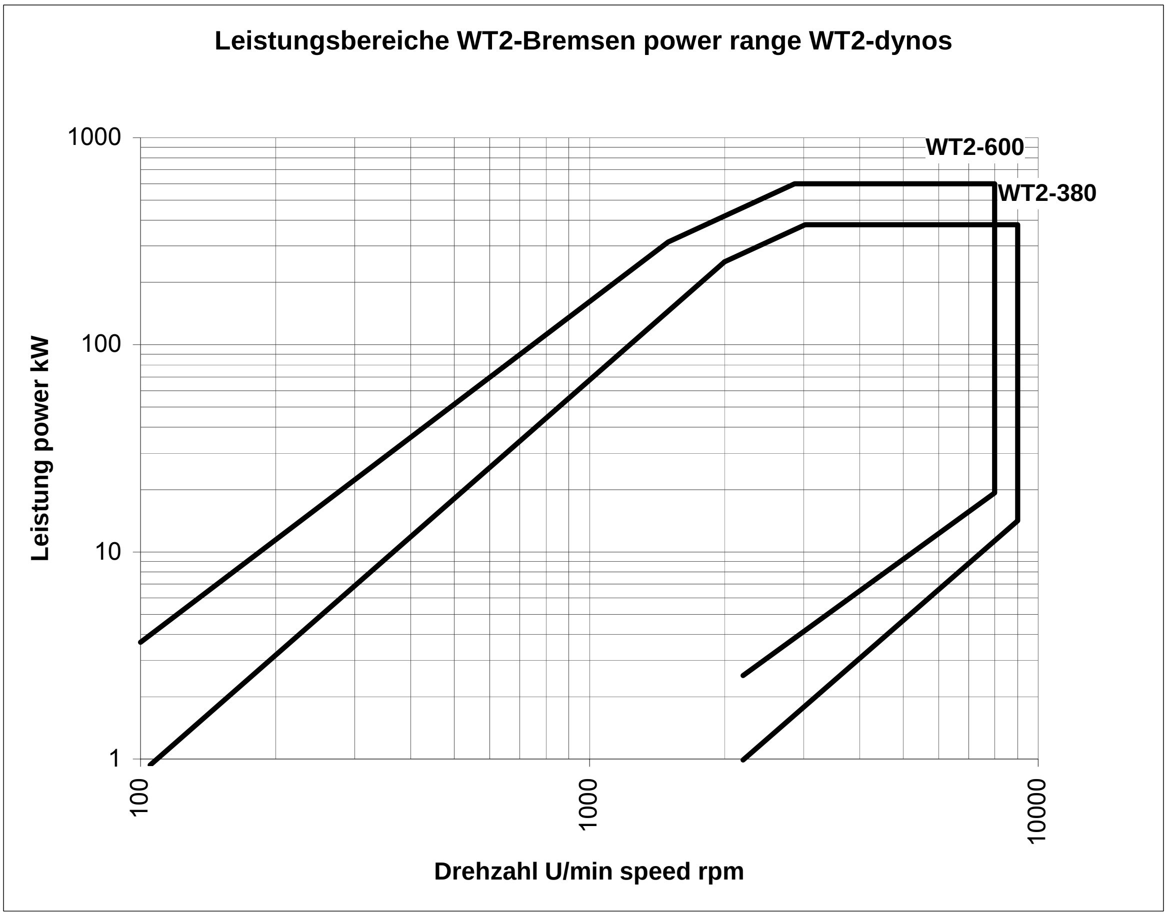

Fig. 8: Power Diagram of Eddy Current Dynamometers type WT2

4.4 Power Supply Unit

The power supply of the eddy-current dynamometer is via power supply unit LEW 2002.

Power supply	V	1 ~ PEN, 230 V, 50/60 Hz ((three-wire 2.5mm^2 with wire termination sockets for connecting to the terminal strip)
Protection by fuse	A	20, ultra-rapid
Command value input	V	0 – 10 analogue
Output Voltage	V	approx. –150 - +170 V
Output Current	A	0 – 20 (maximal value can be set by current limiter)
Operating temperature	°C	0 - +35° without external ventilation 0 - +40° with external ventilation
Transporting and storage temperature	°C	- 25 - + 65°
Relative humidity	%	max. 95, 30 days a year, not condensing class F (DIN 40 050)
Protection system		IP 00 (DIN 40 050) (must be in installed in cabinet or housing)
Weight	kg	10,9

The unit can also be delivered for operation with a power supply of 110V. However, the output voltage is then reduced to approx. –70 - +80V. Due to the reduced setting reserves, transient tests can not usually be driven. The WT2-380 only reaches its rated torque at higher speeds.

4.5 Modules and Cable Lengths

Modules	Total Cable Length	Dimensions
Power supply unit LEW 2002		19“, 2HE
Measuring and Control Cables		
Between test stand controller and power supply unit	2m	
Between test stand controller and eddy-current dynamometer	15m	
Between power supply unit and eddy-current dynamometer	15m	

4.6 Dimensions

On the following pages, you will find foundation dimensions, cooling water connection, flange drawing for shaft connection and dimensioning of the calibration system

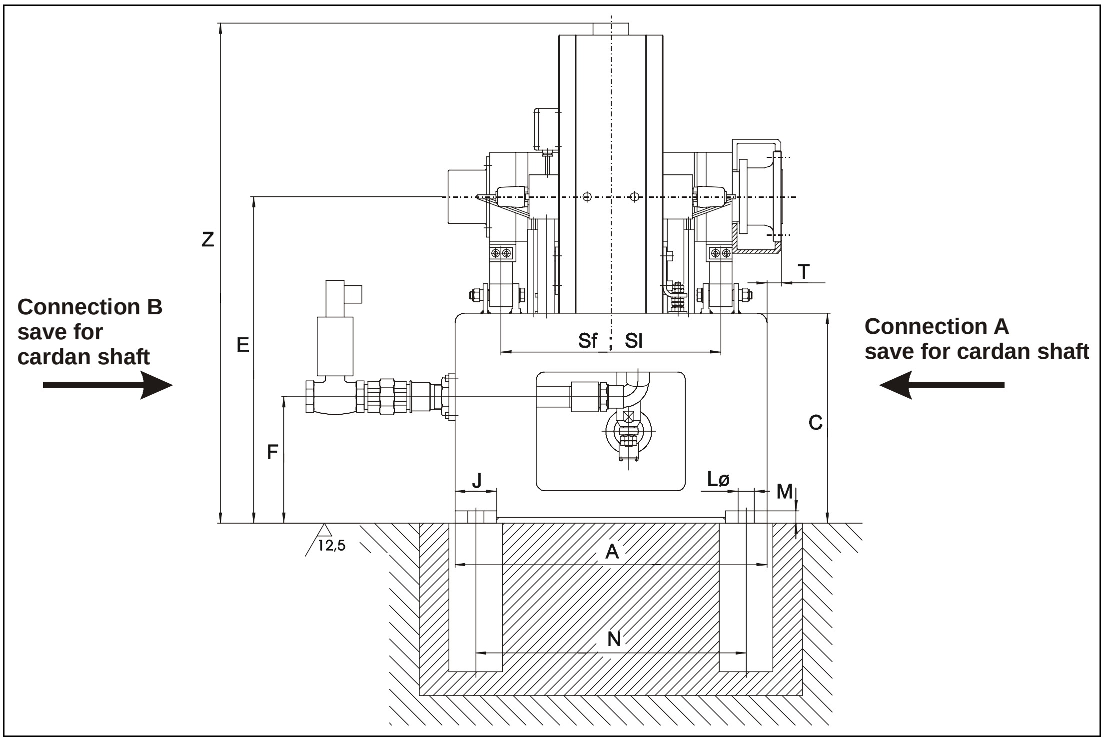

Fig. 9: Pow Side View WT

Dimensions in mm	WT190	WT2-380	WT300	WT2-600	WT470	WTS470
A	525	688	594	820	740	740
C	354	354	480	480	404	404
E	550	550	700	700	700	700
F	213	159	211,5	235	115	115
J	70	70	70	70	70	70
LØ	27	27	27/22	27/22	27/22	27/22
M	21	21	26	26	21	21
N	455	618	524	750	670	670
S-flexure strip	370	523	461	663	576	576
S-trunnion bearing	356	518	437	642	590	590
T	+5,5	+5,5	-13	-8,5	-30	-24,5
Z	823	860	1036	1060	1167	1167

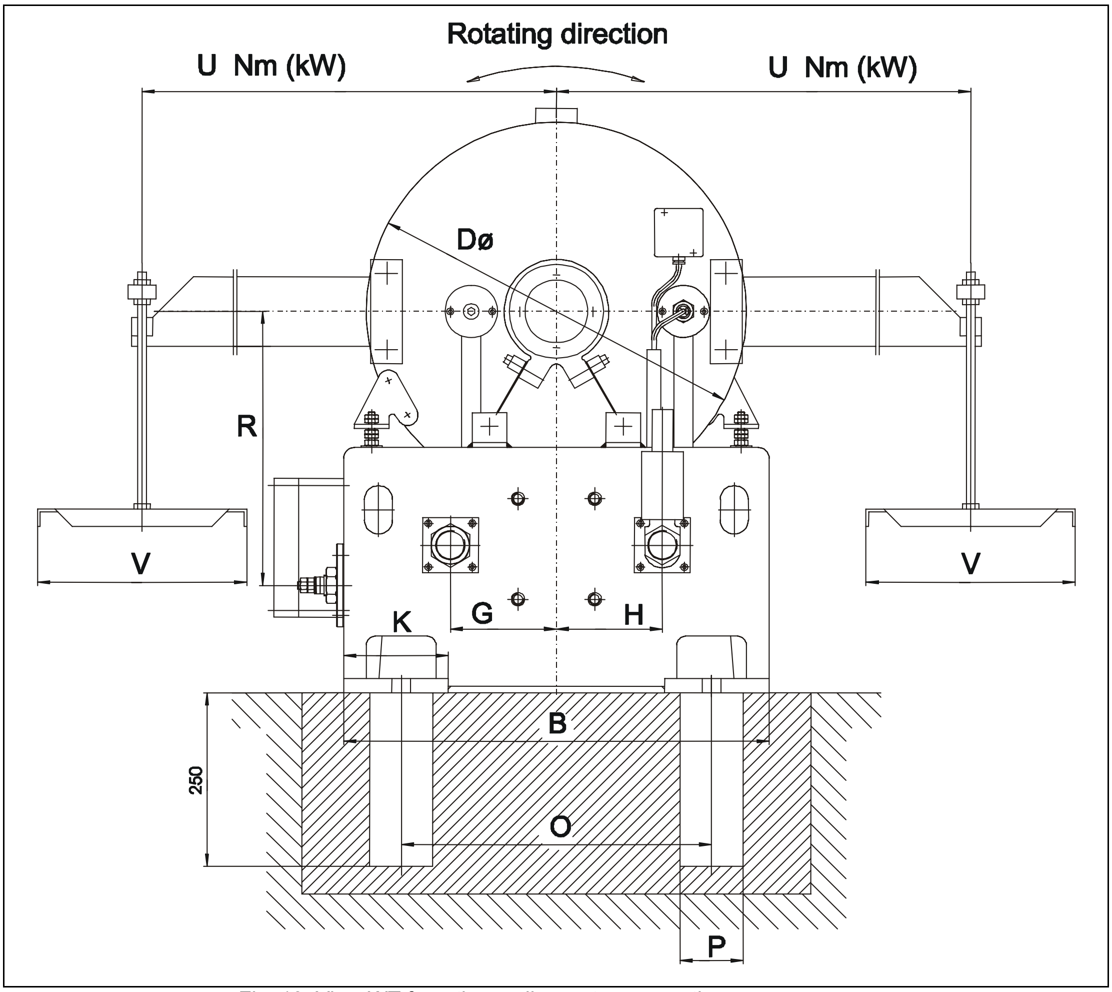

Fig. 10: View WT from the cooling water connection

Dimensions in mm	WT190	WT2-380	WT300	WT2-600	WT470	WTS470
B	610	610	722	722	1000	1000
DØ	545	545	672	672	904	904
G	152	152	192,25	182,5	293,5	293,5
H	152	152	192,25	182,5	203,5	203,5
K	150	150	180	180	180	180
O	445	445	600/500	600/500	840/750	840/750
P	100	100	100	100	100	100
R	395	287	350	350	465,5	465,5
U	1019,7	1019,7	1019,7	1019,7	1529,6	1529,6
V	300	300	300	300	300	300

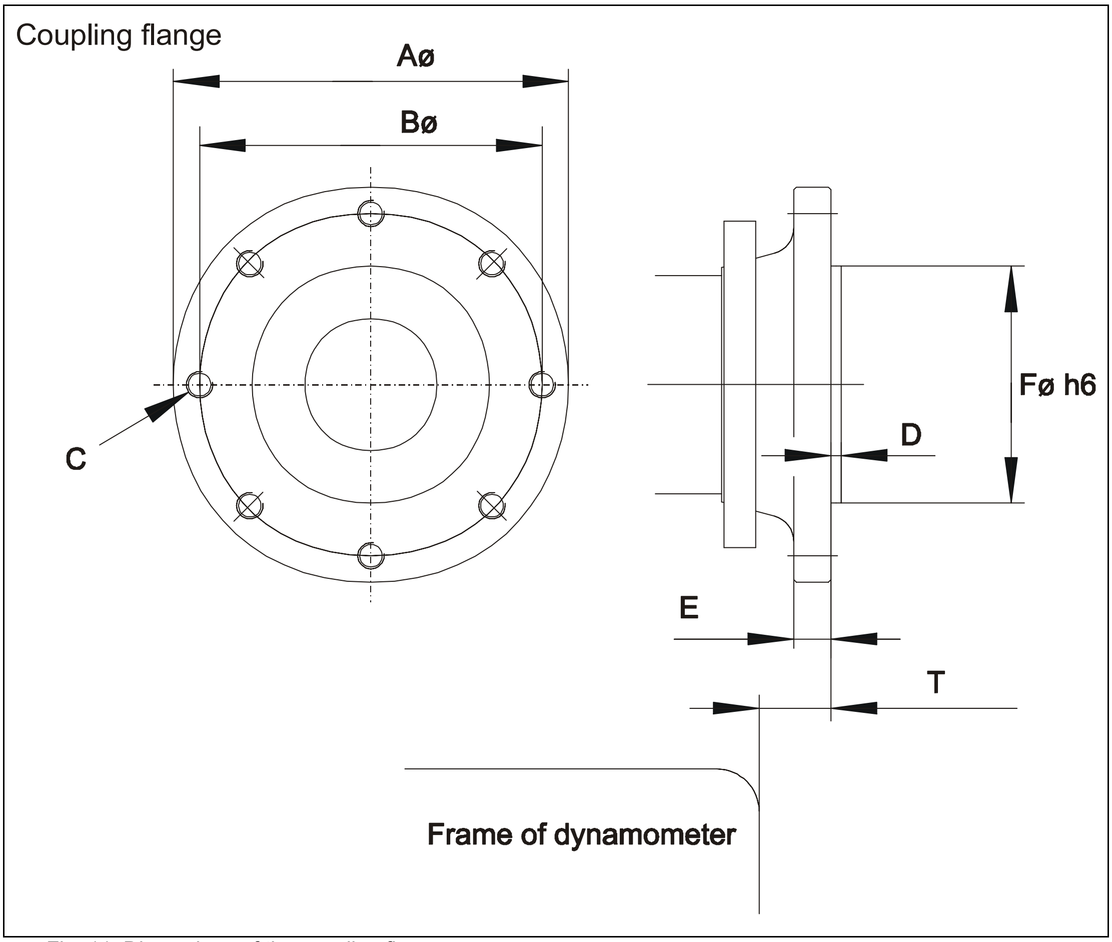

Fig. 11: Dimensions of the coupling flange

Dimensions in mm	WT190	WT2-380	WT300	WT2-600	WT470	WTS470
AØ	150	150	150	180	225	180
BØ	130	130	130	155,5	196	155,5
C	8xM10 8*M12	8xM10 8*M12	8xM10 8*M12	8xM12 8xM16	8xM16	8xM12 8*M16
D	2	2	2	2	3	2
E	14	14	14	18	20	18
FØ	90	90	90	110	140	110
T	+5,5	+5,5	-13	-8,5	-30	-24,5

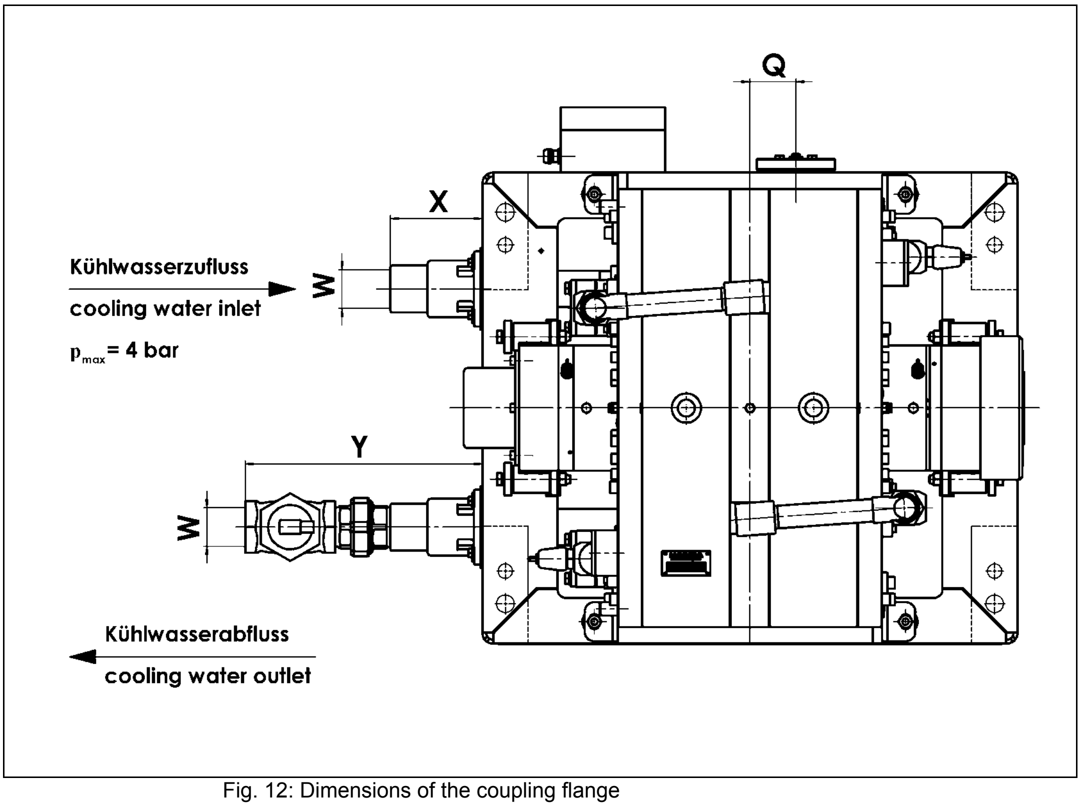

Fig. 12: Dimensions of the coupling flange

Dimensions in mm	WT190	WT2-380	WT300	WT2-600	WT470	WTS470
Q	0	50	0	70,5	0	0
W	G 1 ¼ “	G 1 ½ “	G 1 ½ “	G 2“	G 2 “	G 2 “
X	113	128	128	141	141	141
Y	282	319	319	364	364	364

5 Things You Should Observe

5.1 Set-Up

For calibrating, the weighing scales must be loaded with calibration weights. For that, it is recommended to provide a surrounding free space of at least 0.5 m.

Installation position

- Transversal slope max. ± 15 °
- Longitudinal slope max. ± 15 °

5.2 Transport, Unpacking, Storage

During transport and loading/unloading of the dynamometer, the respective safety regulations for the operation of lifting devices and material handling equipment must be observed.

Transporting and loading/unloading the dynamometer

The dynamometer is carefully packed by the manufacturer and is thus protected against mechanical damage and influences of the weather to a major extent. Nevertheless, heavy impact and extreme weather conditions should be avoided during transport. The packaging containers must not be tilted, tipped or stacked. When packed, the dynamometer should preferably be loaded and unloaded using a fork lift truck or other lifting gear.

Unpacking the dynamometer

When unpacking, make sure the dynamometer is not damaged. In the case of seaworthy packaging, remove the steel hoops first, then the lid and then the side walls of the packaging. After unpacking, check to make sure the dynamometer is complete and undamaged.

Storing the dynamometer

Perfect storage conditions are provided by an air-conditioned room. Bare metal parts must be given a coating of corrosion protection. The dynamometer and all system parts must be protected from dirt and dust. If stored outside air-conditioned rooms, the dynamometer must be sealed in polyethylene sheeting at least 0.2 mm thick with a desiccant (e.g. Silica gel). For this, the air must be sucked out from the inside the cover and a humidity indicator attached visibly. The desiccant must not come into contact with bare metal parts due to the danger of corrosion. The cover must be protected against mechanical damage. The cover must be checked regularly at intervals of around 4 weeks and the desiccant or humidity indicator replaced if necessary. In addition, the transportation protection has to be removed and the rotor has to be turned by an angle of 15 to 20°.

5.3 Cooling Water Supply

The energy converted into heat during braking is dissipated from the dynamometer with the cooling water. The cooling water supply can either be made from the water main (for once-through flow) or from a re-cooling system (cooling water reuse). We recommend to install a magnetic filter in the inlet in order to filter magnetisable particles from the cooling water. In addition, eddy current dynamometers in continuous operation should only be operated over recooled cooling water in a closed circuit, where the recooling takes place via a heat exchanger (not an evaporation cooler) to the cooling water continuously being charged with oxygen. Storage tanks with an open surface must also be avoided due to oxygen charge. We recommend the addition of additives to form a corrosion protection layer and to prevent hardness depositing.

Directly in front of the dynamometer, a simple locking valve for adjustment of the flow required has to be provided. In order to guarantee complete filling of the dynamometer, the pressure difference between inlet and outlet must be at least 0.6 bar. The maximal admission pressure must not exceed 4 bar.

Technical Data:	
Cooling water pressure in front of the dynamometer	0.6 to 4 bar
Cooling water inlet temperature for nominal performance	max. 40 °C
Cooling water outlet temperature	max. 60 °C
Grain size of solid ingredients	max. 1 mm

Standard values cooling water quality

Characteristic value	Unit	Values
pH-Value		7,5 – 8,5
Calcium hardness	mmol/L	1,8 – 3,6
Carbonate hardness	mmol/L	2 - 3
Total salt content (evaporation residue)	mg/l	< 1200
Sulphates SO_4^{2-}	mg/l	< 15
Chlorides Cl^-	mg/l	< 150
Ammonium NH^+_4	mg/l	< 5
Iron Fe	mg/l	< 1,0
Oil content	mg/l	0
Algae growth		not permitted

Even when cooling water quality is observed, the inclination of the water fluctuates between "strongly corrosive" ($SI_{20°C}$ = 7.8) and "strongly depositing" ($SI_{80°C}$ = 3.8) depending on temperature, pH-value Ca-hardness and m-value (carbonate harness).

HORIBA ATS has no influence on the composition of the cooling water used (make-up water as well as flow or circuit water).

The dynos are designed for a high durability which depends among other things on the water quality. In order to achieve a high durability the dynos must be feeded with cooling water which has a usual water quality. Damages as a result of corrosive cooling water are not covered by the warranty.

To prevent damage caused by corrosion and/or deposits, HORIBA ATS recommends consulting a company specialising in water and process conditioning.

This company must prepare a treatment concept depending on process management and the characteristics of the cooling water. The adherence to and effectiveness of this treatment concept must be proved by means of regular water analyses (make-up water and circuit water) for the parameters mentioned in the specification as well as the control of the product concentration (e.g. tracer).

To gain an indication of area corrosion and the effectiveness of corrosion protection measures, HORIBA ATS recommends the installation and regular evaluation of corrosion coupons. Hardness precipitation can be detected through the calcium balance.

In the case of open cooling water systems, the regular examination of the microbiology is recommended in addition, particularly with regard to the presence of "mucus-forming bacteria".

Cooling water consumption

The cooling water consumption is calculated from the power to be dissipated and the permitted temperature difference between inlet and outlet according to the following equation:

$$Q = 0{,}86 * \frac{P}{\Delta t}$$

Q	[m³/h]	= Cooling water quantity
P	[kW]	= Power to be braked down
Δt	[°C]	= Temperature range $t_A - t_E$
t_A	[°C]	= Cooling water outlet temperature
t_E	[°C]	= Cooling water inlet temperature

In order to guarantee the cooling water flow required, a pressure difference between inlet and outlet must exist. The following diagram shows this correlation.

The nomogram following hereafter enables to define the required amount of cooling water Q and pressure reduction Δp for the different sizes of eddy-current dynamometers. These parameters are defined on the basis of engine performance P to be braked down and the temperature difference Δt of cooling water inlet and outlet temperatures.

The parameters are defined as follows:

- Draw a vertical line on the right-hand side of the nomogram above the defined value of temperature difference Δt.
- Draw a horizontal line to the left in the point of intersection of this curve with the curve for the current engine performance P to be braked down and read the required amount of cooling water Q from the respective scale.
- Extend the horizontal line into the left-hand section of the nomogram up to the point of intersection of the curve with the respective eddy-current dynamometer.
- The searched value of pressure drop Δp is found vertically below the point of intersection of the horizontal line with the P_{Rated} curve of the respective rated capacity of the eddy-current dynamometer including pressure governor on the Δp scale.

The nomogram for defining Δp is valid for eddy-current dynamometers type WT including flow governor.

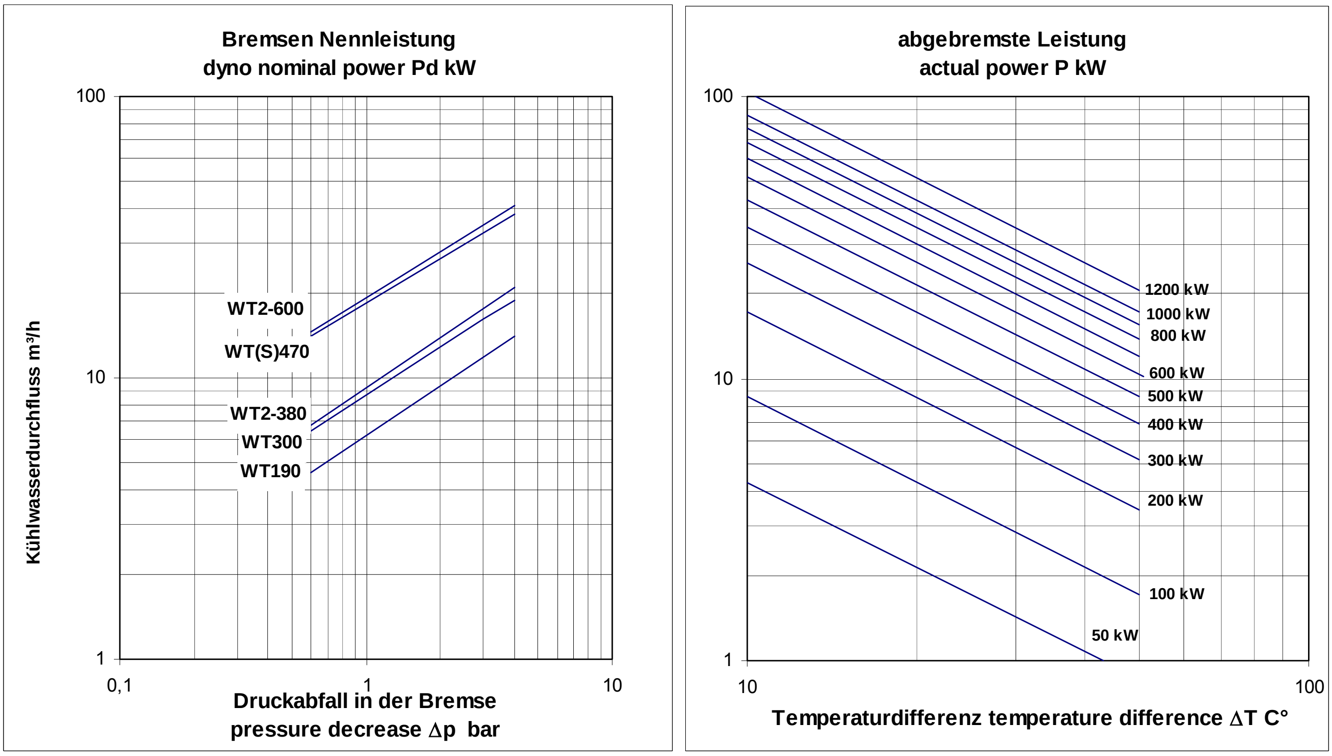

Fig. 13: Cooling Water Flow Depending on the Difference in Water Pressure

5.4 Alternating load

Principle-caused high temperatures at the surface of the cooling chambers arise in eddy current brakes with high load. Eddy current brakes of the series WT are highly-optimized products. Nevertheless large variations in temperature result under strong alternating load. These lead to increased wear.

The power ratings in table in chapter 4.2 and diagram in chapter 4.3 refer to steady state operation. Test cycles with alternating load reduce the life cycle, in particular with fast load changes. As far as the test procedure permits it, we recommend, to smooth the set-points signal for different load levels by ramp functions (10s or longer).

At different legally prescribed cycles, e.g. the EURO3 ELR (European load Response) test, fast, exact load changes are prescribed obligatory. Transient control reactions require a control reserve of approx. 20% of the rated load. Regarding to the increased wear the brake should exhibit clearly higher reserves at frequent driving off of such cycles, typ. 40%. If you have such requirements, please turn to HORIBA ATS for the optimum dimensioning.

Damage to the dynamometer caused by ongoing dynamic overload are not covered by the warranty.

5.5 Shaft Connections

For connecting the engine to be tested with the hydraulic dynamometer, a double-cardanic shaft is required. Please note that there are torsion natural frequencies and bend-critical speeds depending on dynamometer, test specimen and shaft connection. These must not be excited during operation. HORIBA ATS supplies different shafts for all applications. Furthermore, you can request a shaft design particularly for your testing application as a service from us.

All the connection parts you produce or provide yourself (e.g. intermediate discs, flywheels, starter gearings etc.) have to have been balanced to least balancing quality level Q6.3. Radial/axial runout of the centring of these parts must not exceed 0.01% of their outer diameter. Cardan shafts and drive shafts as a link between the test engine and power brake require protection.

5.6 Installation Power Electronics

All 19" modules are designed for installation in 19" housings or 19" control cabinets. HORIBA ATS can supply this measuring cabinet, which can be ordered separately, with basic cabling.

5.7 Assembly and Commissioning

Commissioning cannot be carried out until cooling water pipes have been laid and a test engine has been provided. The foundation must have dried before the dynamometer is fixed in place. For assembly and commissioning we will be pleased to provide experienced fitters and commissioners from our company for you (at a charge).

6 Product Options and Accessories

6.1 Trunnion Bearings

As standard, the dynamometer is supplied cradle-mounted on flexure strips. As an alternative, we offer trunnion bearings. The technical data and dimensions described in chapter "Figures, Data, Facts" do not change due to the use of trunnion bearings.

6.2 Second Coupling Flange

For some applications such as for engines for starting and tractor operation supplied by the customer, a connection to the rear shaft end of the dynamometer is required. For that, the protection cover of the rear end of the shaft will be removed and an additional coupling flange will be installed. The connection drawing (centering diameter, hole circle etc.) as well as the projection of the base frame correspond with the coupling flange of the engine.

For operation with two coupling flanges and connection of masses at both sides, the following must be observed:

- for maintaining the masses coupled on, the speeds allowed have to be reduced to 90% of the corresponding values for one-sided connection and
- for maintaining the speeds, the masses allowed on both sides reduce to 81% of the corresponding values. for one-sided connection

The order numbers for the coupling flanges of the various dynamometer sizes, please take from chapter "Order Numbers"

Scope of supply:

- second coupling flange
- protection cover for coupling flange (The protection cover for the rear end of the shaft is not required)

6.3 Magnetic Filter

6.3.1 How it All Works

Eddy-current dynamometers work according to the eddy current principle and thus have a powerful magnetic field. Cooling water is used to cool the dynamometer. On account of the powerful magnetic field in the eddy-current dynamometer, magnetizable particles in the cooling water are attracted to the dynamometer and become accumulated mainly in the cooling chambers. This accumulation in the cooling chambers is not distributed evenly over the whole cooling surface, it takes place mainly at the water inlet and where the field strength is greatest. This accumulation on the cooling chamber surface then leads to poorer cooling locally and thus to an increased risk of damage to the cooling chambers. In extreme cases, the cooling channels can become extremely clogged and worsen the dynamometer cooling overall. For this reason, magnetizable particles should be filtered out of the cooling water.

The magnetic filters filter the magnetizable particles out of the cooling water through their magnetic field. To be effective, the magnetic filter has to be arranged upstream from the eddy-current dynamometer in terms of the direction of flow of the cooling water. The direction of flow marked on the magnetic filter must be heeded.

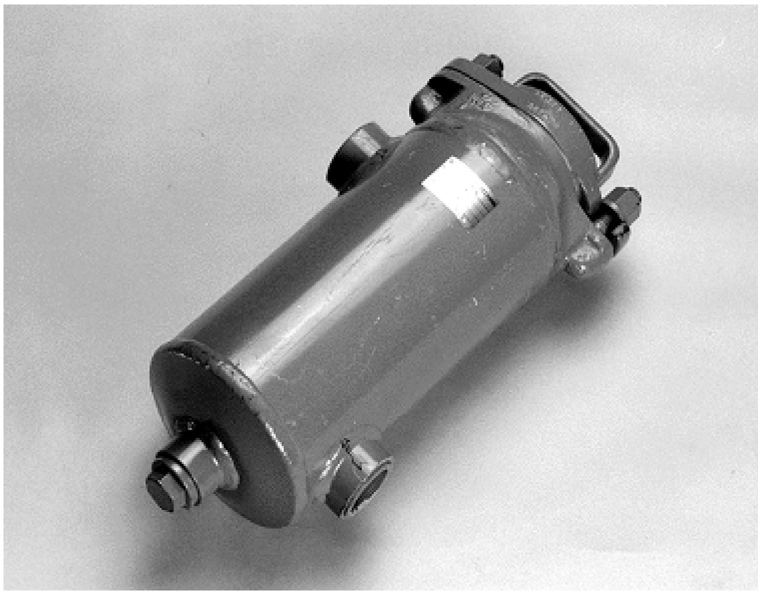

Fig.14: Magnetic filter

The size of the magnetic filter depends on the cooling water requirements of the dynamometer. Please use the technical specification or documentation (operating manual) of the eddy-current dynamometer to determine the cooling water requirements in m³/h. Choose the right magnetic filter size on the basis of this water quantity.

The following assignment table for the magnetic filters for the different eddy-current dynamometers is valid for a **rated power** of the eddy-current dynamometers with usual differences in cooling water temperatures calculated for the temperature difference ranges printed in bold type.

Eddy-current dynamometer type	**Difference in cooling water temperature Δt (outflow to inflow)**						
	10 – 15 °C	**15 - 20 °C**	**20 - 25 °C**	**25 - 30 °C**	**30 - 35 °C**	**35 - 40 °C**	**>=40 °C**
WT190	MFGH-300	MFGH-200	MFGH-150	MFGH-150	DMS-90	DMS-90	DMS-90
WT300	MFGH-600	MFGH-300	MFGH-300	MFGH-200	MFGH-150	MFGH-150	MFGH-150
WT2-380	MFGH-600	MFGH-400	MFGH-300	MFGH-300	MFGH-200	MFGH-200	MFGH-150
WT(S)470	-	MFGH-600	MFGH-400	MFGH-300	MFGH-300	MFGH-200	MFGH-200
WT2-600	-	MFGH-600	MFGH-600	MFGH-400	MFGH-300	MFGH-300	MFGH-300

DMS-xx or MFGH-xxx means a maximum water flow of xxx l/min.

6.3.2 Scope of Supply

The scope of supply includes

- 1 Magnetic filter

Not included in the scope of supply are adapters for different pipe diameters and attachment elements.

6.3.3 Figures, Data, Facts

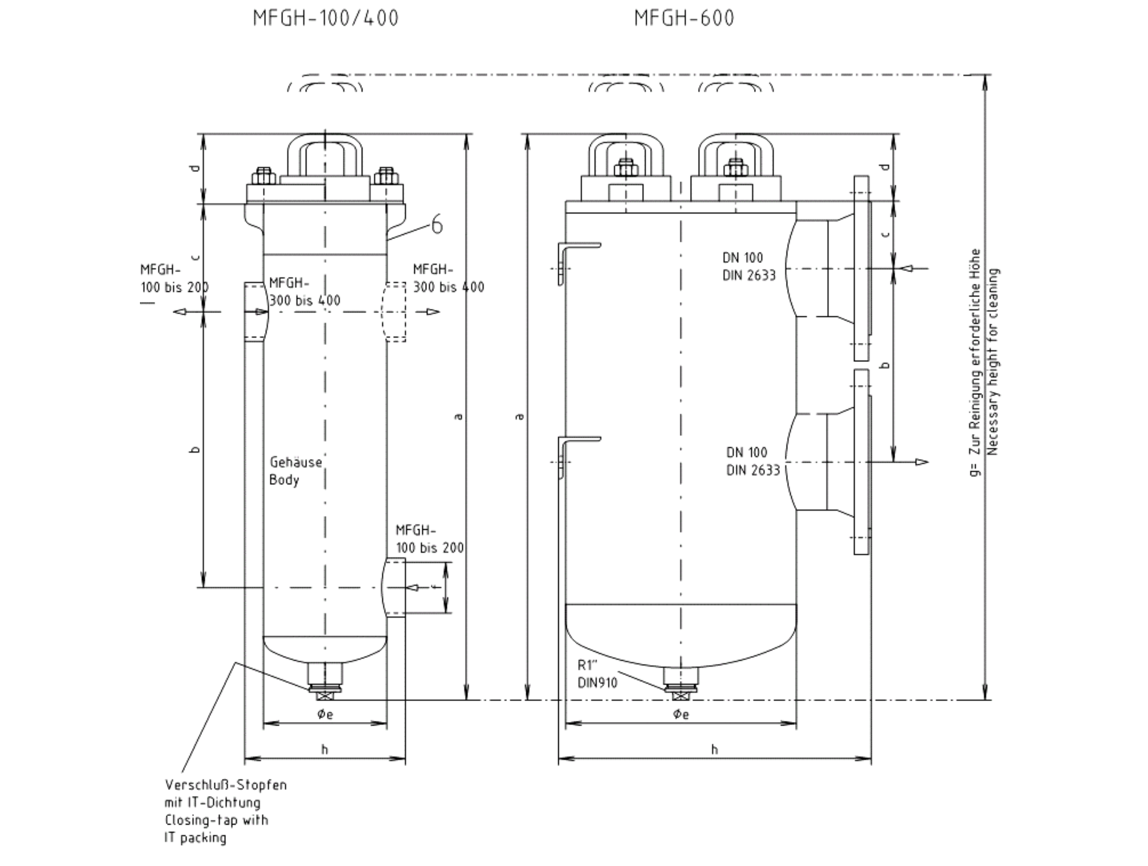

Fig.15: Magnetic filter

Magnetic filter type	Dimensions							Weight	Flow quan-tity	Connec-tion thread
	a	b	c	d	Øe	g*	h			f
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	[m³/h]	-
DMS-20	230	-	50	-	78	375	164	4,6	1,2	G ½“
DMS-45	330	-	50	-	78	525	164	5,8	2,7	G 3/4“
DMS-90	330	-	50	-	78	525	164	6,0	5,4	G 1“
MFGH-100	450	180	95	60	146	700	190	11,0	6,0	G 1 ¼“
MFGH-150	510	230	100	60	146	810	190	12,0	9,0	G 1 ½“
MFGH-200	590	290	110	60	146	950	190	13,0	12,0	G 2“
MFGH-300	660	-	260	60	146	1150	190	18,0	18,0	G 2“
MFGH-400	860	-	350	60	146	1550	190	23,0	24,0	G 2“
MFGH-600	650	230	80	60	273	1150	370	60,0	30,0	NW 100

* Clear size (for cleaning)
Pressure loss approx. 0.1 bar

6.4 Starter System

For test stands without own starter system of the engine, HORIBA ATS GmbH offers a starter system installed at the free end of the shaft of the dynamometer. The power is adapted to the eddy-current dynamometer used (for that, please see our specification „Accessories for Dynamometers").

6.5 Calibration Unit

After each intervention in the area of the load cell or the pendulum body receptacle, a calibration of the eddy-current dynamometer is recommended. For controlling the torque measuring unit, we recommend the HORIBA ATS adjustment system consisting of two testing levers and two weighing scales (for that, please see our specification „Accessories for Dynamometers").

6.6 Measuring Weights

Measuring weights for the calibration unit are available individually and serve for loading the calibration levers for torque adjustment (for that, please see our specification „Accessories for Dynamometers").

6.7 Modification kit WT470 to WTS470

The eddy current dynamometer WT470 can be converted to the high-speed WTS470. Modification takes place at HORIBA ATS.

Please note that the executions flexure support dynamometer and single thrust bearing dynamometer require separate modification kits. The scope of supply presumes the customer will be responsible for delivering the dynamometer to HORIBA and collecting it again.

Scope of supply

Modification kit with rotor with shaft, bearing bush and coupling flange with protective hood, setting plates

Modification work at HORIBA ATS

If further parts such as cooling chambers or rotor bearings should be found to be worn or defective during the modification work, these will be replaced and invoiced separately.

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