

Advanced Neuromonitoring Solutions



The microchip catheter program

for diagnostic applications
in neurosurgery clinics
and practices



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References:

Clinical Neurology and Neurosurgery 120 (2014) 36-40, Clinical experience with telemetric intracranial pressure monitoring in a Danish neurosurgical center, Alexander Lilja, Morten Andresen, Amer Hadi, Dorthe Christoffersen, Marianne Juhler;

Poster (2015) Medstar Washington Hospital Center, Washington, D.C., Raumedic Bolt: Initial clinical experience in a neurosurgical population, MD Rocco Armonda, MD Daniel Felbaum, MD Kyle Mueller, MD Anthony Conte, MD R. Bryan Mason, MD Edward Aulisi;

Childs Nerv Syst (2013), DOI: 10.1007/s00381-013-2324-0, Feasibility of telemetric ICP-guided valve adjustments for complex shunt therapy, Florian Baptist Freimann, M. Schulz, H. Haberl, Ulrich-Wilhelm Thomale;

www.neurosurgery-online.com (2012), Neurosurgery 70: 44-49, DOI: 10.1227/NEU.0b013e31822dda12, First Clinical Results With a New Telemetric Intracranial Pressure-Monitoring System, MD MA Stefan Welschehold, Cand Med Eva Schmalhausen, MD Philippe Dodier, MD Sonja Vulcu, MD PhD Joachim Oertel, MD PhD Wolfgang Wagner, MD Christoph A. Tschan;

Journal of Clinical Neuroscience (2011), DOI:10.1016/j.jocn.2011.04.026, An outcome analysis of two different procedures of burr-hole trephine and external ventricular drainage in acute hydrocephalus, Petra Schödel, Martin Proescholdt, Odo-Winfried Ullrich, Alexander Brawanski, Karl-Michael Schebesch;

www.neurosurgery-online.com (2010), Neurosurgery 67:1716-1723, Evaluation of a Novel Brain Tissue Oxygenation Probe in an Experimental Swine Model, MD Berk Orakcioglu, MD Oliver W. Sakowitz, MD Jan-Oliver Neumann, MD Modar M. Kentar, MD PhD Andreas Unterberg, MD PhD Karl L. Kiening;

Acta Neurochir (2009) DOI 10.1007/s00701-009-0532-x, Brain tissue oxygen monitoring: a study of in vitro accuracy and stability of Neurovent-PTO and Licox sensors, Karlis Purins, Per Enblad, Bo Sandhagen, Anders Lewén;

Acta Neurochir (Wien) (2004) DOI 10.1007/s00701-004-0351-z, Bench test assessment of the new RAUMEDIC Neurovent-P ICP sensor: a technical report by the BrainIT group, G. Citerio, I. Piper, M. Cormio, D. Galli, S. Cazzaniga, P. Enblad, P. Nilsson, C. Contant, and I. Chambers on behalf of the BrainIT Group;

Journal of Neuroscience Methods 139 (2004) 161-165, Accuracy and stability of temperature probes for intracranial application, Beat Alessandri, Bernd M. Hoelper, Robert Behr, Oliver Kempfski;

Acta Neurochir (2003) 145: 185-193, DOI 10.1007/s00701-002-1052-0, Clinical evaluation of a new intracranial pressure monitoring device, R. Stendel, J. Heidenreich, A. Schilling, R. Akhavan-Sigari, R. Kurth, T. Picht, T. Pietilä, O. Suess, C. Kern, J. Meisel, and M. Brock

Microchip catheters with maximum precision NEUROVENT®

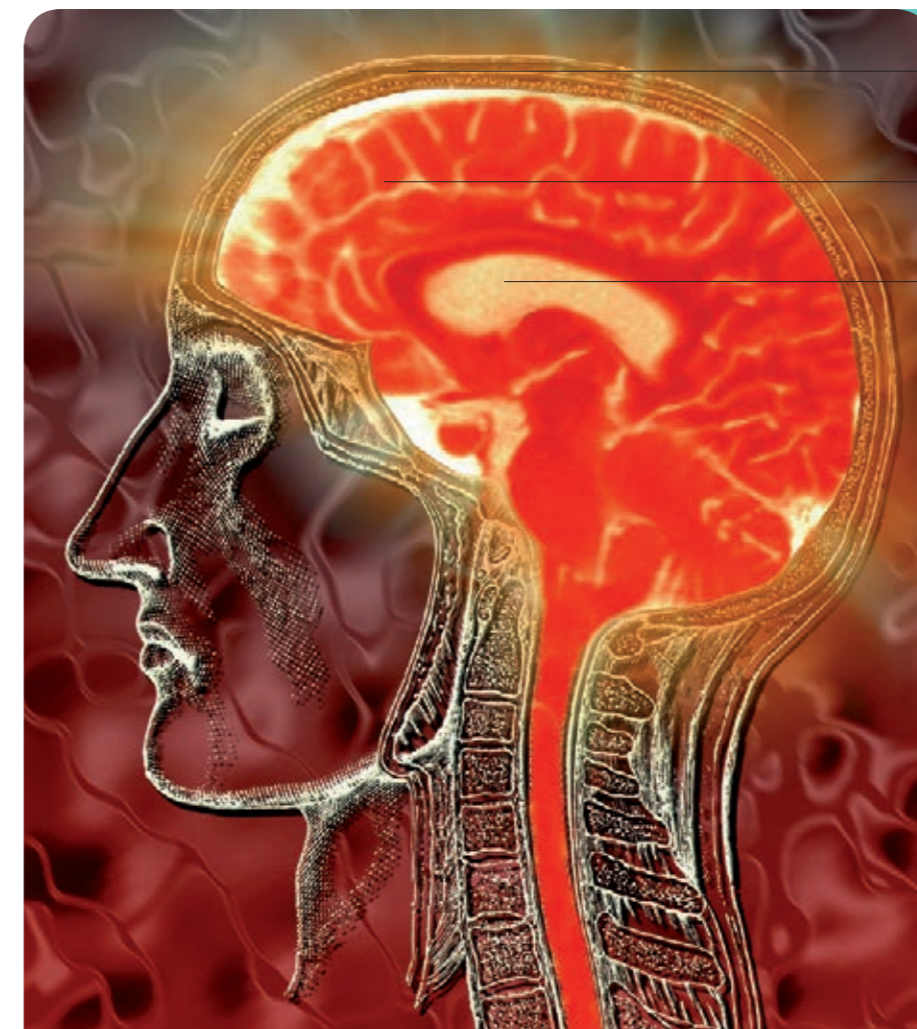
NEUROVENT precision pressure catheters are used in neurosurgical procedures for the reliable measurement of:

- ICP (intracranial pressure)
- ICT (intracranial temperature)
- p_{iO_2} (oxygen partial pressure)

The multi-modal neuromonitoring performed with the measuring catheter in the field of neurosurgery enables early recognition of potential cerebral damages.

ICP is measured using semiconductor pressure sensors. The quenching process of fluorescence is used to measure p_{iO_2} . Consequently, the level and changes in the parameters are measured safely, quickly and accurately.

RAUMEDIC offers a wide range of microchip catheters for parenchymal as well as ventricular and epidural pressure measurement.



Epidural pressure measurement

Parenchymal pressure measurement

Ventricular pressure measurement

NEUROVENT VP 16



NEUROVENT precision pressure catheters are used to perform the following measurements:

Parenchymal

- **NEUROVENT-P**
Parenchymal ICP measurement
- **NEUROVENT-P-TEMP**
Parenchymal ICP and temperature measurement
- **NEUROVENT-PTO**
Parenchymal ICP, temperature and $p_{t_i}O_2$ measurement
- **NEUROVENT-TO**
Parenchymal temperature and $p_{t_i}O_2$ measurement

Ventricular

- **NEUROVENT**
Ventricular ICP measurement and CSF-Drainage
- **NEUROVENT-TEMP**
Ventricular ICP and temperature measurement with CSF-Drainage
- **NEUROVENT-Sleeve Housing**
Ventricular CSF-Drainage and parenchymal ICP measurement
- **NEUROVENT VP 16**
Ventricular CSF-Drainage and parenchymal ICP measurement, neuro-navigable

Epidural

- **NEURODUR**
Epidural ICP measurement
- **NEURODUR-TEMP**
Epidural ICP and temperature measurement

Clinical advantages:

- Parenchymal pressure, temperature and $p_{t_i}O_2$ measurement in one catheter
- Easy handling via Plug & Play system – no catheter calibration required
- Direct connection without an intermediate monitor to the patient monitor (Except NEUROVENT-PTO/-PTO 2L and -TO)
- Compatible with all standard patient monitors
- MR conditional up to 3 Tesla – no surgical intervention and disposition of the catheter required
- Easy monitor change without measurement loss of ICP is possible using zero point simulator (NPS2)
- Excellent measurement stability and linearity
- Reproducible pressure curve rendition with highly accurate rendering capabilities of fine structures for wave analysis
- Range suitable for all applications (parenchymal, ventricular, epidural)
- Centimeter scale (numeric every 5 cm and BOLT-mark)

RAUMEDIC precision multiparameter catheters prevent measuring errors:

- ▲ Opening of CSF-Drainage
- ▼ Closing of CSF-Drainage

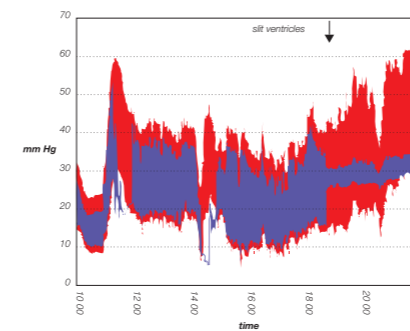


Figure 1: Pressure measurement with slit ventricles

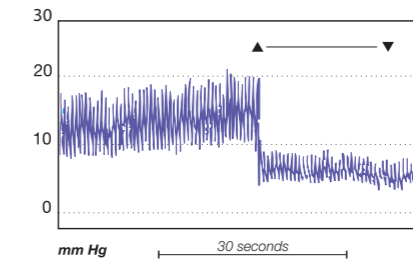


Figure 2: Comparison catheter

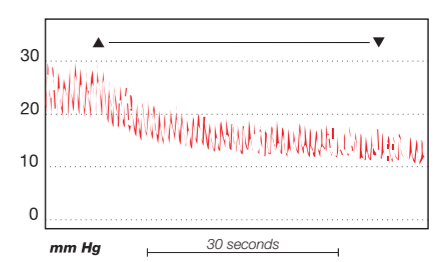


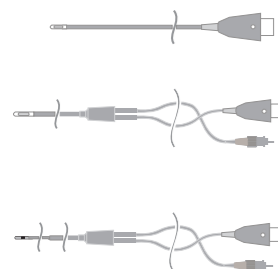
Figure 3: NEUROVENT

- 1) Precise measurement of the pressure variation (red curve) using RAUMEDIC-NEUROVENT in comparison with measurement using a catheter with an external transducer (blue curve); the latter reveals failures and incorrect measurements. Figure 1
- 2) Opening and closing of a CSF-Drainage: Measurement using a ventricular catheter with an external transducer. The jump in pressure upon opening of the CSF-Drainage represents an artefact. Figure 2
- 3) Continuous, artefact-free measuring of the ICP using RAUMEDIC-NEUROVENT. Figure 3

Microchip catheter program

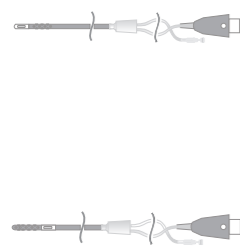


Parenchymal measurements



Product	Version	Dimension	Article number
NEUROVENT-P	ICP	5F	092 946
NEUROVENT-P-TEMP	ICP + temperature	5F	094 268
NEUROVENT-PTO	ICP + temperature + p _t O ₂ delivered with BOLT-DRILL KIT PTO	5F	095 008 092 380
NEUROVENT-PTO Treatment KIT	Catheter + BOLT KIT PTO + DRILL KIT CH5	5F	096 274
NEUROVENT-PTO 2L	ICP + temperature + p _t O ₂	5F	095 108
NEUROVENT-TO	Temperature + p _t O ₂ delivered with BOLT-DRILL KIT PTO	3F	095 908 092 380
NEUROVENT-TO Treatment KIT	Catheter + BOLT KIT PTO + DRILL KIT CH5	3F	096 284

Ventricular measurements



Product	Version	Dimension	Article number
NEUROVENT	ICP + drainage, with stylet	9F	092 956
NEUROVENT 6F	ICP + drainage	6F	094 678
NEUROVENT-IFD-S	ICP + drainage soft internal guide wire	9F	091 678
NEUROVENT-IFD-R	ICP + drainage rigid internal guide wire	9F	095 317
NEUROVENT-Sleeve Housing (ventricular + parenchymal)	ICP + drainage, with sleeve housing Ventricle drainage, ICP in the parenchyma	9F	091 576
NEUROVENT VP 16 (ventricular + parenchymal)	ICP drainage, neuro navigable Ventricle drainage, ICP in the parenchyma	9F	096 704
NEUROVENT-TEMP	ICP + drainage + temperature, with stylet	9F	094 278
NEUROVENT-TEMP-IFD-S	ICP + drainage + temperature soft internal guide wire	9F	094 288
NEUROVENT-TEMP-IFD-R	ICP + drainage + temperature rigid internal guide wire	9F	095 327

Epidural measurements



Product	Version	Dimension	Article number
NEURODUR	ICP	5,8 x 2,1 mm (measurement head)	092 976
NEURODUR-TEMP	ICP + temperature	5,8 x 2,1 mm (measurement head)	094 298

Technical data

Pressure measurement range	-40 to +400 mmHg (-5,3 to 53 kPa)
Upper cut-off frequency	20,000 Hz (-3 dB)
Catheter material	Polyurethane
Measurement range temperature sensor	+25 °C to +45 °C
Pressure sensitivity	5 μV/mmHg
Measurement* range p _t O ₂	0-200 mmHg
Electrical catheter length (tip to connector)	
- Parenchymal	approx. 55 cm
- Ventricular	approx. 55 cm
- Epidural	approx. 55 cm

* Measurement accuracy ± 2,5 mmHg
p_tO₂ (for < 120 mmHg p_tO₂)

Zero Drift Pressure

Ø Deviation 0,6 mmHg after 5 days*

* Bench test assessment of the new Raumedic Neurovent-P ICP sensor: a technical report by the BrainIT group Citerio G., Piper I., Cormio M., Galli D., Cazzaniga S., Enblad P., Nilsson P., Contant C., and Chambers I., BrainIT Group Acta Neurochirurgica (Wien). 2004, Aug; DOI: 10.1007/s00701-004-0351-z

NEUROVENT-P



NEUROVENT



NEURODUR



Accessories for transferring measurement values to the patient monitor

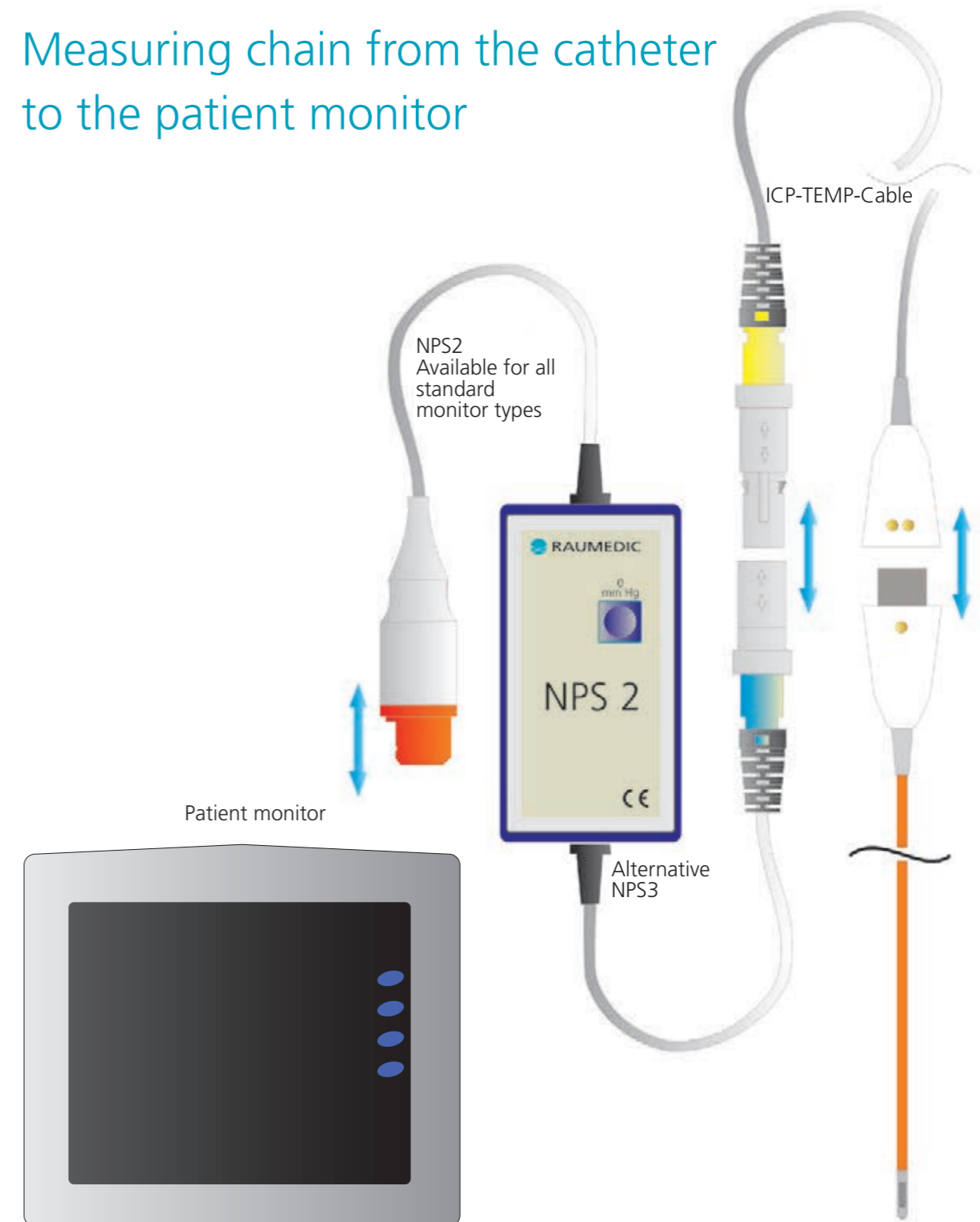
Product	Description	Article number
ICP-TEMP-Cable	Connecting cable between ICP catheter and zero point simulator NPS2	094 328
ICP-TEMP-Adapter	Adapter between zero point simulator NPS2 and patient monitor	094 323
ICP-TEMP-Adapter Philips/HP	Adapter between zero point simulator NPS2 and patient monitor Philips/HP	094 047
NPS2 Siemens/Dräger Infinity	Adapter cable to Siemens/Dräger Infinity patient monitor	092 627
NPS2 Philips/HP	Adapter cable to Philips/HP patient monitor	092 637
NPS2 Nihon Kohden BSM 41xx	Adapter cable to Nihon Kohden BSM 41xx patient monitor	094 716
NPS2 GE/MARQUETTE	Adapter cable to GE/MARQUETTE patient monitor	093 807
NPS2 Datex Ohmeda	Adapter cable to Datex Ohmeda patient monitor	090 924
NPS2 SpaceLabs	Adapter cable to SpaceLabs patient monitor	091 715
NPS2 Fukuda Denshi	Adapter cable to Fukuda Denshi patient monitor	096 003

Zero point simulator NPS2 for further monitor types upon request

Clinical advantages:

- Direct connection to the patient monitor without ICP monitor
- Easy handling via Plug & Play system – no calibration required
- Easy monitor change without measurement loss of ICP is possible using zero point simulator (NPS2)

Measuring chain from the catheter to the patient monitor



Telemetric ICP measurement NEUROVENT®-P-tel

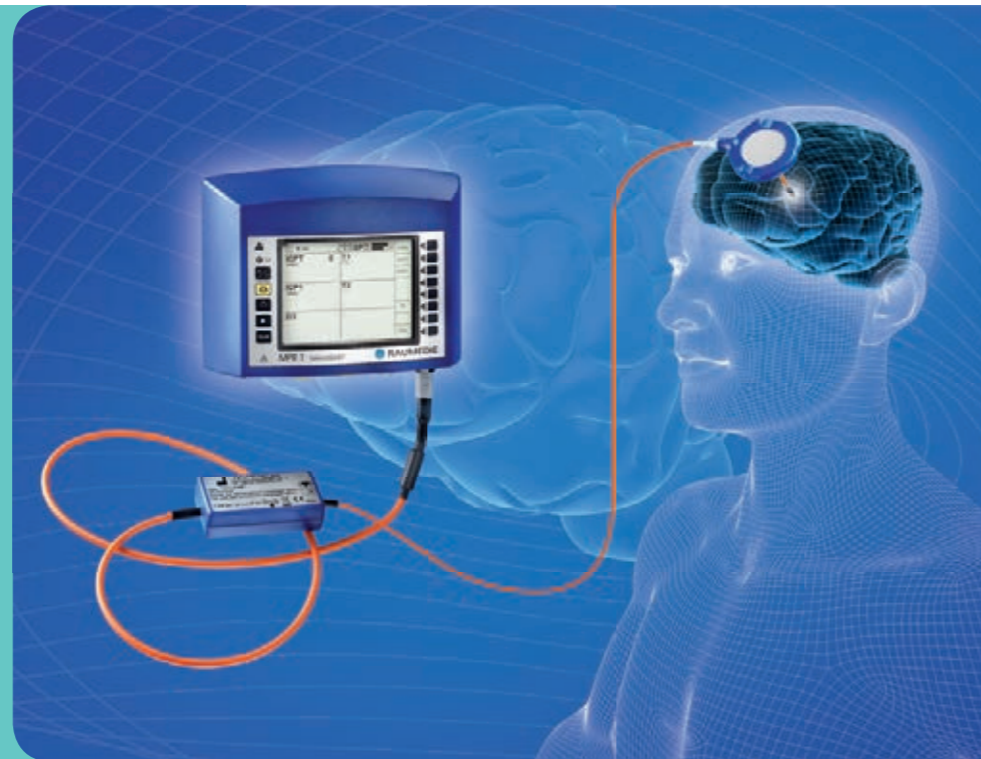
For the parenchymal ICP measurement RAUMEDIC offers the transdermal telemetry system. The telemetry pressure catheter **NEUROVENT-P-tel** is fully implanted below the scalp onto the cranial bone.

The telemetric system measures ICP using microchip technology which transfers pressure values over the closed scalp using validated RFID principles to a reader

Reader TDT1 readP. The data is captured and stored on the **MPR 1 DATALOGGER**.

Clinical advantages:

- Wireless communication with the telemetry catheter
- Completely implantable pressure measuring catheter
- Data acquisition using RAUMEDIC MPR 1 DATALOGGER
- USB data transfer to PC / laptop possible
- Mobile patient monitoring for inpatients
- Use of the telemetry catheter for up to 3 month



Product	Description	Article number
NEUROVENT-P-tel	Parenchymal telemetry catheter	096 504
Reader TDT1 readP	RFID reader for communication with the telemetry catheter	096 524
MPR 1 DATALOGGER	Data recording and storage	094 474
DRILL KIT CH5	For NEUROVENT-P-tel	091 878

NEUROVENT-P-tel

Parenchymal telemetry catheter

- 5F catheter tube
- Catheter length 30 mm
- MR conditional

NEUROVENT-P-tel



Reader TDT1 readP

RFID reader for communication with the telemetry catheters

- Telemetric capture of pressure measurement values
- Connects to the RAUMEDIC MPR 1 DATALOGGER

Reader TDT1 readP



MPR 1 DATALOGGER

Measurement and storage of pressure measurements in a single handy device

- Display of telemetric ICP readings
- Suitable for mobile use thanks to low weight
- Simple and safe operating interface
- Analog output and USB interface
- Mains / battery operation
- Display of ICP, ART, CPP and temperature is possible with applicable catheters

MPR 1 DATALOGGER



Oxygen partial pressure measurement NEUROVENT®-PTO

Oxygen partial pressure measurement records the available oxygen in the brain tissue. This ensures possible cerebral damage is quickly detected and appropriate measures for the avoidance of cerebral ischaemia can be taken.

Clinical advantages:

- Parenchymal pressure, temperature and $p_{ti}O_2$ measurement in one catheter
- Easy handling via Plug & Play system – no calibration required
- No oxygen consumption by the O_2 sensor
- No scattered light sensitivity
- No refrigeration required
- Data recording and storage using RAUMEDIC MPR2 logO DATALOGGER
- Data display using RAUMEDIC EASY logO



MPR2 logO DATALOGGER



EASY logO

→ Mains operation	yes	yes
→ Rechargeable battery	yes	no
→ 2 x Analog output (Transfer of pressure value)	yes	yes
→ USB interface	yes	no
→ Data storage	yes	no
→ Curves	yes	no
→ Display of		
- ICP	yes	yes
- $p_{ti}O_2$	yes	yes
- Temperature	yes	yes
- ICPA	yes	yes
- ART	yes	no
- CPP	yes	no
is possible with applicable catheters		

NEUROVENT-PTO

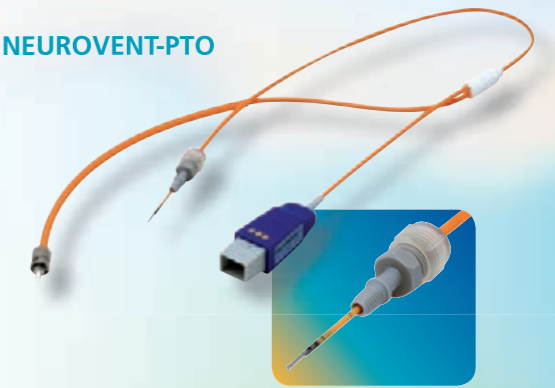
One catheter – Three measurement functions

→ ICP

→ Temperature

→ $p_{ti}O_2$

NEUROVENT-PTO



NEUROVENT-TO

Catheter for measuring temperature and $p_{ti}O_2$

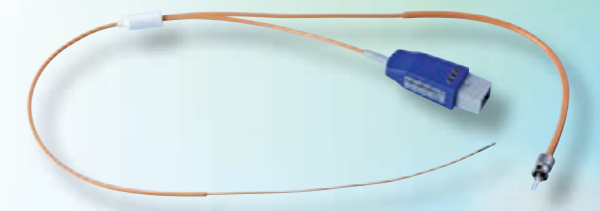
NEUROVENT-TO



NEUROVENT-PTO 2L

Unique catheter for craniotomies which measures ICP, temperature and $p_{ti}O_2$; besides application with the BOLT KIT PTO 2L and a microdialysis catheter

NEUROVENT-PTO 2L



BOLT KIT PTO 2L

Two lumen BOLT for safe and functional implantation of the NEUROVENT-PTO 2L and a microdialysis catheter

BOLT KIT PTO 2L



Product	Version	Dimension	Article number
NEUROVENT-PTO	ICP + temperature + $p_{ti}O_2$ delivered with BOLT-DRILL KIT PTO	5F	095 008 092 380
NEUROVENT-PTO Treatment KIT	Catheter + BOLT KIT PTO + DRILL KIT CH5	5F	096 274
NEUROVENT-TO	Temperature + $p_{ti}O_2$ delivered with BOLT-DRILL KIT PTO	3F	095 908 092 380
NEUROVENT-TO Treatment KIT	Catheter + BOLT KIT PTO + DRILL KIT CH5	3F	096 284
NEUROVENT-PTO 2L	ICP + temperature + $p_{ti}O_2$	5F	095 108
BOLT KIT PTO 2L	only for NEUROVENT-PTO 2L	CH9	096 076
EASY logO	Data display		095 264
MPR2 logO DATALOGGER	Data recording and storage		095 254



Cables and Accessories (for the MPR 1/2)

Product	Description	Article number
Cable PTO	Connecting cable for transferring pressure and temperature signals to the MPR2 logO DATALOGGER	095 624
Cable LWL	Fibre optic connecting cable for transferring the oxygen signal to the MPR2 logO DATALOGGER	095 657
ICP-TEMP-Cable	Connecting cable between ICP catheter and MPR 1/2	094 328
ICP-TEMP-Adapter	Adapter between ICP-TEMP-Cable and MPR 1/2	094 323
Power supply DATALOGGER	Power supply	283 967
Wide range power adapter MPR 1/2	Power supply	284 007
Stand Holder DATALOGGER	Pole mounting device	283 957
Table Stand DATALOGGER	For use as a table mounted device	283 959
Shoulder strap DATALOGGER	For fastening the MPR 1/2 to the patient	283 960
Software DATALOG	PC analysis software based on Excel	283 962
USB-Cable	Connecting cable between MPR 1/2 and a PC/laptop	283 949

Connecting Cables (MPR 1/2 to patient monitor)

Product	Description	Article number
Cable DATALOGGER GE/MARQUETTE	Connecting cable between MPR 1/2 and GE/MARQUETTE patient monitor	094 858
Cable DATALOGGER Philips/HP	Connecting cable between MPR 1/2 and Philips/HP patient monitor	094 868
Cable DATALOGGER Siemens/Dräger Infinity	Connecting cable between MPR 1/2 and Siemens/Dräger Infinity patient monitor	094 878
Cable DATALOGGER SpaceLabs	Connecting cable between MPR 1/2 and SpaceLabs patient monitor	094 967
Cable DATALOGGER Datex Ohmeda	Connecting cable between MPR 1/2 and Datex Ohmeda patient monitor	094 888
Cable DATALOGGER Hellige	Connecting cable between MPR 1/2 and Hellige patient monitor	094 898
Cable DATALOGGER Nihon Kohden	Connecting cable between MPR 1/2 and Nihon Kohden patient monitor	096 006

Transducer Cables (Transducer to MPR 1/2)

Product	Description	Article number
Transducercable DATALOGGER Smith Medical	Connecting cable between MPR 1/2 and disposable transducer (Smith Medical DPT-6100)	094 908
Transducercable DATALOGGER Medex MX 960	Connecting cable between MPR 1/2 and disposable transducer (Medex)	095 974
Transducercable DATALOGGER pvb xtrans	Connecting cable between MPR 1/2 and disposable transducer (pvb xtrans)	096 494
Transducercable DATALOGGER Becton Dickinson	Connecting cable between MPR 1/2 and disposable transducer (BD PMSET 1DT-XX)	096 046
Transducercable DATALOGGER Edwards TRUWAVE	Connecting cable between MPR 1/2 and disposable transducer (Edwards TRUWAVE)	096 036
Transducer DATALOGGER		283 956

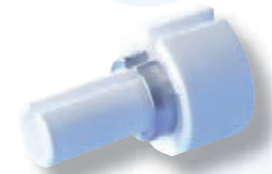
BOLT CH9



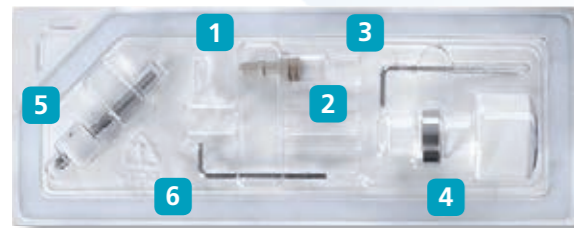
BOLT CH5



Screw-in tool



BOLT-DRILL KIT components



RALK-Hand Drill, autoclavable



RAUMEDIC – BOLT KIT and DRILL KIT

Safe and functional fastening of the catheter is achieved using the **BOLT KIT**. Other accessories for catheter application are the **RALK-Hand Drill** and the **DRILL KIT**.

BOLT KIT advantages:

- Suitable for all imaging methods
- Low BOLT height
- Self-cutting thread with sealing function

BOLT KIT components:

- 1 Polymer screw with seal
- 2 Fixing cap
- 3 Dura opener
- 4 Screw-in tool

DRILL KIT components:

- 5 Drill bit with stopper
- 6 Allen key

Product	Description	Article number
BOLT KIT CH5	For parenchymal catheters	091 868
DRILL KIT CH5	For BOLT KIT CH5	091 878
BOLT-DRILL KIT CH5	Set for parenchymal catheters	091 888
BOLT KIT CH9	For ventricular catheters	091 688
DRILL KIT CH9	For BOLT KIT CH9	091 668
BOLT-DRILL KIT CH9	Set for ventricular catheters	091 898
BOLT KIT PTO	Only for NEUROVENT-PTO/-TO	096 026
BOLT-DRILL KIT PTO	Set for NEUROVENT-PTO/-TO	092 380
RALK-Hand Drill	Autoclavable drill	231 584

RAUMEDIC – Spliceable Tunneling Sleeve

The Spliceable Tunneling Sleeve is suitable for routing the RAUMEDIC catheter and is intended for single use only.

The main advantage of the Spliceable Tunneling Sleeve is the contamination-free application of the catheter and its complete, trouble-free removal after fastening of the catheter.

Product	Article number
Spliceable Tunneling Sleeve CH8 (for parenchymal catheters)	090 506
Spliceable Tunneling Sleeve CH12 (for ventricular catheters)	090 717



Advantages:

- Trocar with optimized cutting geometry
- Atraumatic adaptation of the tip for low resistance application
- Spliceable Tunneling Sleeve made of biocompatible, polymer material
- Coloured tear-off strip for easy use

VENTRICULAR CATHETER
1-lumen tunneling
version



CSF-Drainage



REM IMAGE OF THE RAUMEDIC PU VENTRICULAR CATHETER*



* PU: Polyurethane

REM IMAGE OF A STANDARD VENTRICULAR CATHETER, TYPICALLY OF SILICONE



RAUMEDIC – disposable ventricular catheters

The catheters are used for external ventricular drainage (EVD).

VENTRICULAR CATHETER, 1-lumen tunneling version

- Including trocar, stylet, Luer connector, butterfly and clamp
- Compatible with all standard pressure transducers
- Polyurethane catheter 30 cm long
- Length scale provided

CSF-Drainage

- System for draining and collecting CSF
- Accessories
Replacement bag and filter for CSF-Drainage

Material

- RAUMEDIC PU-catheter with smooth surface structure

Product	Version	Packaging	Article number
Ventricular catheter	CH9 / 300 mm tunneling version	10 pcs / pack	870 772
CSF-Drainage		15 pcs / pack	095 377
Spare bag for CSF-Drainage		10 pcs / pack	095 424
Spare filter for CSF-Drainage		10 pcs / pack	095 568
Ventricular catheter	1-Lumen CH9 / 300 mm (long)	5 pcs / pack	871 621
Ventricular catheter	1-Lumen CH9 / 200 mm (short)	5 pcs / pack	871 871
Ventricular catheter	2-Lumen CH9 / 300 mm (long)	5 pcs / pack	871 631
Ventricular catheter	2-Lumen CH9 / 200 mm (short)	5 pcs / pack	871 881
Ventricular catheter	3-Lumen CH9 / 300 mm (long)	5 pcs / pack	871 641
Ventricular catheter	3-Lumen CH9 / 200 mm (short)	5 pcs / pack	871 891

Clinical advantages:

- User-friendly application
- Easy application using BOLT or Tunneling Sleeve
- Immediate liquor checking through transparent catheter tube
- Reliable location identification due to titanium ball or X-ray contrast strips
- Compatible with all standard pressure transducers
- Kink-resistant
- 1-, 2- and 3-lumen catheters also available

Service Worldwide!

RAUMEDIC Brain Competence



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