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Biomedical

TNT 12000
X-Ray Test Tools

Technical Data

The TNT 12000 X-Ray Test Tools system is the newest and most comprehensive family of instruments available for assuring quality and safety of diagnostic x-ray imaging systems. With selection of all-in-one-exposure solid-state detector, dosimeter, ion chambers, optional mA/mAs invasive shunt or non-invasive clamp device, and choice of handheld display or laptop interface (both completely wireless), the TNT 12000 X-Ray Test Tools provide state-of-the-art solutions for any x-ray test protocol. A long battery life ensures uninterrupted operation all day.

The TNT 12000WD solid-state detector sets up in seconds and measures kVp, dose, dose rate, time, and half value layer (HVL) in a single exposure. The companion TNT 12000 DoseMate dosimeter and ion chambers provide precision dose and dose-rate measurement of radiographic, dental, fluoroscopic, and CT imaging systems. The wireless ZigBee® interface allows for quick testing and reporting, and at less than 1 mW power is preferred over Bluetooth® in medical settings where interference with delicate patient monitoring and treatment equipment may be a concern.

Key features

- Choice of all-in-one detector, dosimeter, integral mA/mAs, handheld display or user's own laptop interface
- ZigBee wireless operation
- Compact handheld design
- Sets up in seconds
- Displays all values in one shot (TNT 12000WD)
- Simple user interface
- Unbeatable ruggedness for long-term reliability
- 40 kHz kV sampling rate to ensure accuracy with the most difficult applications (TNT 12000WD)
- Global support network delivering prompt service and peace of mind to Fluke Biomedical customers worldwide

System components

TNT 12000WD Wireless Detector

Featuring all-in-one-exposure measurements and ZigBee wireless communication combined with the rugged, reliable, and accurate design that is a Fluke trademark, the TNT 12000WD is a new breed of non-invasive x-ray test tool. Its compact design enhances portability and wireless operation ensures setup in seconds.

Because the TNT 12000WD measures all parameters with every exposure, there is no need for complicated menu selection, further enhancing user productivity. TNT 12000WD always defaults to the last use when powered on, so when used often for repetitive procedures it is truly a one-button (power on) solution. TNT 12000WD has the expanded functionality needed for modern applications and can be managed with minimum keystrokes. Users can identify and select custom measurement protocols and save them for future use. Full test automation and documentation software is available for TNT 12000WD, creating the advantage of accurate, repeatable testing processes.

TNT 12000 DoseMate dosimeter

The TNT 12000 DoseMate with ion chambers provides the precision dose measurements needed for absolute dose measurement integrity. Offering customizable measurement protocols, the DoseMate dosimeter provides comprehensive, repeatable testing for radiographic, dental, fluoroscopic, and CT imaging systems in just a few keystrokes. The TNT 12000 DoseMate is compatible with existing TRIAD™ external ion chambers. For NERO® customers we have a special ion chamber exchange program. TNT12000 DoseMate offers the newest dosimeter technology with minimum investment.

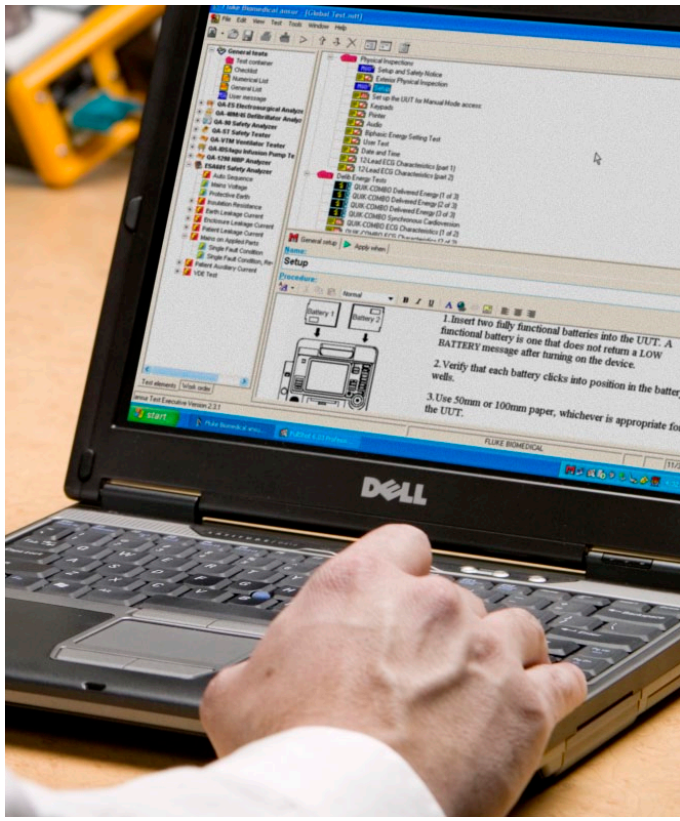
mA/mAs measurement

Integrated mA/mAs measurement capability is available with both the TNT 12000WD and the TNT 12000 DoseMate. A mA/mAs-standard invasive shunt or optional non-invasive clamp device are available to meet the challenges of mAs measurement with all types of x-ray systems. ZigBee wireless interface delivers measured results to the user's choice of handheld display or laptop, integrating all QA measurements on a single readout.

TNT 12000D Wireless Display

The TNT 12000D Wireless Display has been specifically designed with user productivity in mind and displays all measured results, as well as identification information, battery level, calibration date and more. ZigBee wireless interface from the test device offers targeted communication to the mating display for speedy results reading up to 100 feet from the test device. Wireless communication and intelligent device interface allows the user to perform multiple exposures without leaving the radiation-shielded area, thus allowing complete test protocols to be performed with minimum travel between operator and test device. Low power requirements for ZigBee interface allow for extensive battery life as compared to Bluetooth test devices, which require frequent recharging from inefficient power drain.

Ansur Test Automation Software



Test automation software allows preventative maintenance routines to be tightly controlled and consistently reported while directing users through prescribed test protocols with simple and efficient instruction. Test standardization minimizes human error and alleviates training requirements with step-by-step instruction. Photos, drawings, and instructional visual aids included in test protocols negate the need to carry bulky service manuals for complicated PM procedures. Professional electronic reporting and database/CMMS interface allows for total PM and service data management.

We asked a real TNT 12000 user

What is the #1 benefit of the TNT 12000 in your personal experience?
"The TNT 12000 makes my testing regime very simple and very simple to explain."

How would you rate the ease of use of the TNT 12000 compared to devices you've used in the past?
"The TNT 12000 has very high ease of use. On a scale of 1-10, I'd call it a 9."

How would you rate the durability/reliability of the TNT 12000 compared to devices you've used in the past?
"You can tell by looking at the TNT 12000 that it's durable—it looks overbuilt. I carry it around in a suitcase, throw it in the car, and subject it to lots of different temperatures. The solid-state technology makes it more durable. It seems far more resistant to extreme cold or heat than other devices I've used in the past."

Would you recommend the TNT 12000 as a good investment to other industry professionals, and if so why?
"Yes, and not only to other physicists but also to state agencies who need to go in and test equipment. This is something they can hang their hat on and call it the industry standard for test accuracy."

– Frederic Mis PhD, CHP

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Technical specifications

TNT 12000 X-Ray Test Tools		
Physical specifications		
Display	320 x 240 Color LCD	
Size (WxDxH)	TNT 12000D Display	15.5 cm x 11.4 cm x 4.1 cm (6.1 in x 4.5 in x 1.6 in)
	TNT 12000WD Wireless Detector	17 cm x 11.4 cm x 4.4 cm (6.7 in x 4.5 in x 1.75 in)
	TNT 12000 DoseMate Dosimeter	
Weight	TNT 12000D Display	0.422 kg (0.93 lb)
	TNT 12000WD Wireless Detector	0.7 kg (1.5 lb)
	TNT 12000 DoseMate Dosimeter	0.5 kg (1.1 lb)
Electrical specifications		
Battery	Type	Lithium-ion 3.7 V 4000 mAh
	Charge time	Approximately 5 hr
	Operating duration	Approximately 8 hr minimum
AC adapter	Input voltage	100 V ac to 240 V ac
	Input frequency	50/60 Hz
	Input current	0.5 A (rms)
	Output voltage	6 V dc
Environmental specifications		
Operating temperature	0 °C to 35 °C (32 °F to 122 °F)	
Storage temperature	–35 °C to 50 °C (–31 °F to 122 °F)	
Operating humidity	20 % to 80 % RH (non-condensing)	

TNT 12000WD Wireless Detector		
kVp measurements		
Units	kVp Average (average of peaks during a specified interval)	
	kVp Max (highest peak during a specified interval)	
	PPV (peak practical voltage)	
Ranges	Radio/Fluoro modes	40 kV to 150 kV
	Mammo modes	Mo/Mo: 22 kV to 35 kV
	Rh/Rh	25 kV to 49 kV
	Mo/Rh	22 kV to 40 kV
	Mo/Al	22 kV to 49 kV
	Rh/Al	22 kV to 49 kV
	W/Rh	22 kV to 39 kV
	W/Ag	22 kV to 39 kV
Resolution	0.1 kV	
Accuracy	Radio/Fluoro modes	± 2 % or ± 1 kV, whichever is greater
	Mammo modes	± 2 % or ± 0.7 kV, whichever is greater
Reproducibility	± 1 % (std of 5 readings)	
Filtration correction range	Radio/Fluoro modes	1 mm Al to 10 mm Al or equivalent
	Mammo modes	0 mm Al to 0.4 mm Al added filtration

TNT 12000WD Wireless Detector continued		
Dose/exposure measurements		
Units	Roentgens, Grays	
Range	0.5 mR to 999 R	
	5 µGy to 999 Gy	
Resolution	1 µR	
	0.01 µGy	
Accuracy	± 5 %	
Reproducibility	± 0.5 % (std of 5 readings)	
Filtration correction range	Radio/Fluoro modes	1 mm Al to 10 mm Al or equivalent
	Mammo modes	0 mm Al to 0.4 mm Al added filtration
kV correction range	Radio/Fluoro modes	40 kV to 150 kV
	Mammo modes	Mo/Mo: 22 kV to 35 kV
Dose/exposure rate measurements		
Units	Roentgens or Grays per hour, minute second, pulse	
Range	8 mR/s to 10 R/s	
	70 µGy/s to 100 mGy/s	
	130 µR/pulse to 160 mR/pulse (@ 60 pps)	
	1.2 µGy/pulse to 1.4 mGy/pulse (@ 60 pps)	
Accuracy	± 5 %	
Filtration correction range	Radio/Fluoro modes	1 mm Al to 10 mm Al or equivalent
	Mammo modes	0 mm Al to 0.4 mm Al added filtration
kV correction range	Radio/Fluoro modes	40 kV to 150 kV
	Mammo modes	Mo/Mo: 22 kV to 35 kV
Exposure time: radiographic modes		
Units	Milliseconds, pulses	
Range (@ stated accuracy)	Milliseconds	10 ms to 9999 ms
	Pulses	1 pulse to 999 pulses
Resolution	Milliseconds	0.1 ms
	Pulses	1 pulse
Accuracy	Milliseconds	1 % or 0.5 ms
	Pulses	± 1 pulse
Reproducibility	Milliseconds	1 % or 0.5 ms
	Pulses	± 1 pulse
Elapsed time: fluoro modes		
Range	1 sec to 9999 sec	
Resolution	0.1 sec	
Accuracy	1 % or 0.5 sec	
Average pulse rate: pulsed fluoro		
Range	1 pps to 999 pps	
Resolution	1 pps	
Accuracy	1 pps	

Average pulse width: pulsed fluoro		
Range	10 ms to 999 ms	
Resolution	0.1 ms	
Accuracy	1 % or 0.5 ms	
Half Value Layer (HVL)		
Range	Radio/Fluoro modes	1.2 mm Al to 10 mm Al (equivalent)
	Mammo modes	0.2 mm Al to 0.6 Al (equivalent)
Resolution	Radio/Fluoro modes	0.1 mm Al (equivalent)
	Mammo modes	0.01 mm Al (equivalent)
Accuracy	Radio/Fluoro modes	± 10 % or 0.2 mm Al (equivalent)
	Mammo modes	± 5 % or 0.05 mm Al (equivalent)

TNT 12000 DoseMate Dosimeter	
Accuracy	
Exposure and exposure rate accuracy	± 1 % of reading ± 2 range resolution steps over range of 18 °C to 28 °C and ± 2 % of reading ± 2 range resolution steps over the full operating temperature range of 0 °C to 50 °C
	3 % NIST-traceable calibration is provided with each system and includes effects of 96035B, and 96020C
Measurement modes	
Dose	Autoranging across five decades of sensitive ranges
	Automatic drift and offset compensation
	Automatic post-exposure display hold
Rate	Measurement range covers a span from low-level image intensifier measurements to unattenuated, direct beams
	Automatic offset compensation and nonlinear filtering
	Autoranging provides five decades of sensitivity ranges
	Display updates once per second
Low rate mode	
This mode is only for making very low dose rate measurements. Nonlinear digital filtering and autoranging provide five decades of sensitivity ranges. Display updates once per second. In this mode, automatic current offset and drift compensation are disabled. As a result, the system can display very low dose rates	
Power requirements	
Bias voltage supply	Fixed electronic bias (~300 V)
	Bias voltage removed from triaxial input connector at instrument turnoff
Connections	
Ion chamber input	Triax, BNC
	Collector and guard positive-biased relative to ion chamber body and service dosimeter chassis
Power	Same as TNT 12000WD

96020C and 96035B Diagnostic Ion Chambers		
	96020C	**96035B**
Energy range	30 kVp to 150 kVp	30 kVp to 150 kVp for diagnostic measurements
		20 kVp to 50 kVp for mammographic measurements
Nominal volume	150 cm^3; 11.30 cm diameter by 1.5 cm thick active volume	15 cm^3; 3.96 cm diameter by 1.22 cm thick active volume
Nominal sensitivity	H60: 2.08 x 10^7 R/C at 22 °C and 760 mmHg (optimized for low-level image intensifier and cine measurements)	L100: 2.0 x 10^8 R/C at 22 °C and 760 mmHg Mo/Mo28: 2.21 x 10^8 R/C at 22 °C and 760 mmHg. (flat energy response suitable for conventional diagnostic radiography and mammography)
Leakage current	< 10 fA under normal bias conditions (300 V)	
Collection efficiency	95 % at 2,000 R/min	95 % at 5,000 R/min
Wall material	Composite graphite-filled thermo-plastic	Graphite-coated acrylic (methylmethacrylate)
Window material	0.76 mm thick, graphite-coated polycarbonate	Both entrance windows are made of 0.25 mm graphite-coated polycarbonate
Window density	91 mg/cm^2	32 mg/cm^2
Active window area	100 cm^2, centered within the chamber body	Each side of the chamber has a circular active window region centered 7.1 mm further from the BNC connector than the center of the chamber body; active window regions have an area of 12.32 cm^2
Collector plate	0.8 mm thick graphite-coated acrylic plate, 10.80 cm in diameter; 2.16 cm x 2.85 cm guard region electrically isolated from collector area	0.25 mm thick, centrally mounted, graphite-coated, polycarbonate plate, 3.18 cm, ± 0.01 cm in diameter; 1.27 cm x 0.89 cm guard region is electrically isolated from the collector area
Connector	Side-mounted, triaxial, two-lug BNC connector	
Calibration	Standard calibration performed at H60 (NIST defined as 60 kVp, first HVL of 6 mm Al, homogeneity coefficient of 94)	Standard calibration performed at one diagnostic and one mammographic beam quality
		Calibration factors normalized to 22 °C and 760 mmHg diagnostic unattenuated beam
		Calibration on diagnostic side of chamber is performed at L100 (NIST defined as 100 kVp, first HVL of 2.30 mm Al, homogeneity coefficient of 58)
		Calibration on mammographic side performed at Mo/Mo28 (NIST defined as 28 kVp, first HVL of 0.332 mm Al, homogeneity coefficient of 74.3) or MV30 (PTB defined as 30 kVp, first HVL of 0.337 mm Al)

Ion chamber	Units	Effective range***	Resolution step size
15 cc	R	100 µ to 20	1 µ
	R/s	100 µ to 20	1 µ
	R/m	5 m to 1200	50 µ
	R/h	100 m to 72 k	1 m
	R/f**	2 µ to 333 m	0.02 µ
	Gy	1 µ to 175 m	0.01 µ
	Gy/s	1 µ to 174 m	0.01 µ
	Gy/m	50 µ to 10.5	0.5 µ
	Gy/h	1 m to 630	0.01 µ
	Gy/f**	0.02 µ to 2.9 m	0.2 µ
150 cc	R	10 µ to 2	0.1 µ
	R/s	10 µ to 2	0.1 µ
	R/m	0.5 m to 120	5 µ
	R/h	10 m to 7.2 k	0.1 m
	R/f**	0.2 µ to 33 m	0.002 µ
	Gy	0.1 µ to 17.5 m	0.001 µ
	Gy/s	0.1 µ to 17.5 m	0.001 µ
	Gy/m	5 µ to 1050 m	.05 µ
	Gy/h	0.1 m to 63	0.001 m
	Gy/f**	0.002 µ to 290 µ	0.02 n
150 cc low rate mode	R/s	2 µ to 2*	0.1 µ
	R/m	0.1 m to 120*	5 µ
	R/h	2 m to 72 k*	0.1 m
	R/f**	0.04 µ to 33 m*	0.002 µ
	Gy/s	0.02 µ to 17.5 m*	0.001 µ
	Gy/m	1 µ to 1050 m*	0.05 µ
	Gy/h	0.02 m to 63*	0.001 m
	Gy/f**	0.4 n to 290 µ	0.02 n
Electrical units	C	1 p to 100 n	0.01 p
	A	1 p to 100 n	0.01 p

Values for ion chambers are calculated using nominal sensitivities: 15 cc: 2.4 x 10^8 R/C, 150 cc: 2.4 x 10^7 R/C.
*Very Low Dose Rate effective range at 5 % resolution steps. **At 60 f/s (1 to 120 frames/selectable).
***IEC 61674 effective range at 1 % resolution steps.

mA/mAs Specifications		
Measurement range	**Min**	**Max**
Invasive mAs (with shunt) mA/mAs ranges*	0.00	99.99
	100.0	999.9
	1000	1999
Non-invasive mAs (with clamp) mA/mAs ranges	5 mAs	999.9
	1000	3999
*mAs measurements are fully auto-ranging, so values are display ranges only		
Accuracy		
Invasive mAs (with shunt)	± 1 %	

Advanced

Includes:
- Solid-state detector
- Handheld display
- DoseMate dosimeter with integrated mA/mAs
- Non-invasive clamp
- Ion chambers
- Laptop interface
- Ansur compliance software

Complete diagnostic imaging equipment testing, reporting and risk management solution for OEM field service engineers.

Intermediate

Includes:
- Solid-state detector
- Handheld display
- DoseMate dosimeter ion chambers
- Laptop interface
- Excel reporting software

Full test and service kit with automated reporting capabilities. Tailored for medical physicists and QA personnel with elevated compliance routines/ requirements.

Standard

Includes:
- Solid-state detector
- Handheld display
- Laptop interface
- Excel reporting software

Fast and simple in-and-out testing. Perfect for biomedical technicians, inspectors, routine testers, and on-the-go trouble-shooters.

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Ordering information

Item numbers/descriptions

TNT-ALLN1-TNT TNT 12000WD Wireless Detector with mAs + TNT 12000 DoseMate + TNT 12000D Display
TNT-ALLN1-DM TNT 12000WD Wireless Detector + TNT 12000 DoseMate with mAs + TNT 12000D Display
TNTWD-RO-MAS TNT 12000WD Wireless Detector with mAs + TNT 12000D Display
TNT-DM-MAS-RO TNT 12000 DoseMate with mAs + TNT 12000D Display
TNTWD-DM-RO TNT 12000WD Wireless Detector + TNT 12000 DoseMate + TNT 12000D Display
TNT 12000 TNT 12000WD Wireless Detector + TNT 12000D Display
TNT-WMAS-DM TNT 12000WD Wireless Detector with mAs + TNT 12000 DoseMate
TNTWD-DM-MAS TNT 12000WD Wireless Detector + TNT 12000 DoseMate with mAs
TNTWD-DM TNT 12000WD Wireless Detector + TNT 12000 DoseMate
TNTWD-MAS TNT 12000WD Wireless Detector with mAs
TNT12K-DM-MAS TNT 12000 DoseMate with mAs
TNT 12000WD TNT 12000WD Wireless Detector
TNT 12000D TNT 12000D Wireless Display
TNT12K-DM TNT 12000 DoseMate Dosimeter
TNT12K-DM-RO TNT 12000 DoseMate + TNT 12000D Display

*Customized configurations also available. For more information, contact Fluke Biomedical.

Optional accessories

96020C Diagnostic Ionization Chamber, 150 cc
96035B Diagnostic Ionization Chamber, 15 cc
500-200 CT Ion Chamber, 10 cc
500-100 CT Ion Chamber, 3.2 cc
86020 Triax Cable, Male to Male, BNC, 20 ft
EM4524-C-240 mA Cable Assembly, Male to Female, BNC, 20 ft (mAs options only)
PROBE Clamp, Probe, AD/DC mA Leakage (mAs options only)
ANSUR TNT 12000 TNT 12000 Ansur Test Automation Software Plug-In (TNT 12000WD only)

Included with every TNT 12000 system

- TNT 12000 EXL add-in reporting software places measured values into customizable Microsoft® Excel templates that can be used for records maintenance and reporting
- ZigBee USB dongle facilitates direct wireless interface between the detector instrument and the user's PC, negating the need for an additional readout device
- USB cable facilitates PC interface, Excel reporting, and Ansur test automation
- Customized carrying case specifically designed to maximize system portability

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About Fluke Biomedical

Fluke Biomedical is the world's leading manufacturer of quality biomedical test and simulation products. In addition, Fluke Biomedical provides the latest medical imaging and oncology quality-assurance solutions for regulatory compliance. Highly credentialed and equipped with a NVLAP Lab Code 200566-6 accredited laboratory, Fluke Biomedical also offers the best in quality and customer service for all your equipment calibration needs.

Today, biomedical personnel must meet the increasing regulatory pressures, higher quality standards, and rapid technological growth, while performing their work faster and more efficiently than ever. Fluke Biomedical provides a diverse range of software and hardware tools to meet today's challenges.

Fluke Biomedical Regulatory Commitment

As a medical test device manufacturer, we recognize and follow certain quality standards and certifications when developing our products. We are ISO 9001 and ISO 13485 medical device certified and our products are:

- CE Certified, where required
- NIST Traceable and Calibrated
- UL, CSA, ETL Certified, where required
- NRC Compliant, where required

Fluke Biomedical.
Better products. More choices. One company.

Fluke Biomedical
6045 Cochran Road
Cleveland, OH 44139-3303 U.S.A.

Fluke Biomedical Europe
Science Park Eindhoven 5110
5692EC Son, The Netherlands

For more information, contact us:
In the U.S.A. (800) 850-4608 or
Fax (440) 349-2307
In Europe/M-East/Africa +31 40 267 5435 or
Fax +31 40 267 5436
From other countries +1 (440) 248-9300 or
Fax +1 (440) 349-2307
Email: sales@flukebiomedical.com
Web access: www.flukebiomedical.com

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