

eBook | Virtus heavy-duty pressure and flow controllers

# Gain Efficiency through Dynamic Control, Fine-tuned with Digital Precision

Digital empowered hydronic balancing and control for optimized district heating and cooling networks.

ENGINEERING  
TOMORROW

*Danfoss*

**20%**

of energy saving  
potential using  
hydronic balancing  
controls



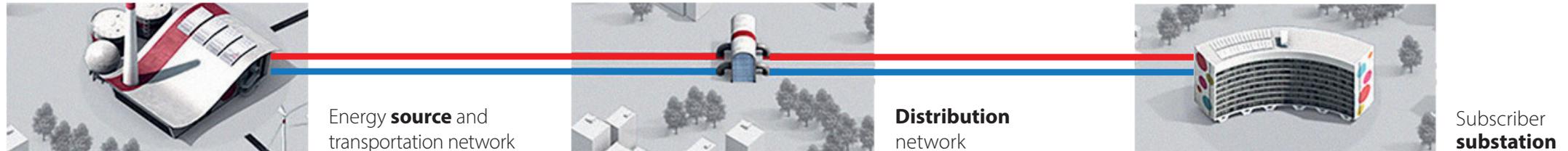
[virtus.danfoss.com](http://virtus.danfoss.com)

# Explore Virtus; innovative optimization of district energy networks

– from energy generation to building application

Optimal hydronic balance and perfect temperature control is the key to maximizing efficiency of heating and cooling networks. With that it also means that you are saving energy, money and improving end-users' comfort.

To help achieve your goals, Danfoss developed a range of heavy duty differential pressure and flow controllers for most demanding district heating and cooling applications, named **Virtus**. They are designed to be used in energy source, transportation network, distribution network and subscriber substation.



In this ebook



Benefits of Virtus



Virtus retrofit solution



Digital optimization iSET and iNET



# Benefits of **Virtus**

## Perfect control & stability

### Efficient network hydronic balancing and $\Delta T$ optimization with advanced pressure- and flow controllers

Design without dynamic sealing between cone and valve body ensures low hysteresis and optimal inner pressure conditions and balancing. Split characteristic and high control ratio for improved control and accuracy.

Perfect hydronic balancing of your system improves  $\Delta T$  and leads to economical balance between temperature and flow. Operational costs will be reduced, system efficiency improved.

**Primary energy generation cost will be reduced for min. 1% for each 3° of  $\Delta T$  increase.**

## Big flow capacities

### Big flow capacities and optimal network design reduces investment costs and improves network efficiency

Danfoss' Virtus pressure and flow controllers with big flow capacities are able to control the pressures and flows even in largest and most demanding district heating and cooling systems where big heat/cold is required.

By use of smaller valve DN with "XXL" flow capacity and by proper network planning and dimensioning, **investment could be reduced for up to 17%**, compared to traditional design. Therefore, Virtus has the best-in-class flow/ investment ratio.

**Differential pressure variation** without and with Virtus differential pressure control



**Best**  
in-class flow/  
invest ratio.



## >> Benefits of **Virtus**

### Remote and dynamic range-ability

#### Increase the control ratio up to 300:1

Virtus offers an optional upgrade of the pressure actuators with intelligent solutions iSET or iNET. These provide remote adjustments to the pressure setting values. That means that the control ratio, also known as range-ability is increased. The maximum flow can be increased by setting pressure to maximal value, and minimum flow decreased by lowering the pressure setting to the minimal value. By adding the dynamic AMEi 6 actuator with iSET or iNET functionality, the range-ability can be increased up to 300:1.

[Read more about iSET and iNET](#)

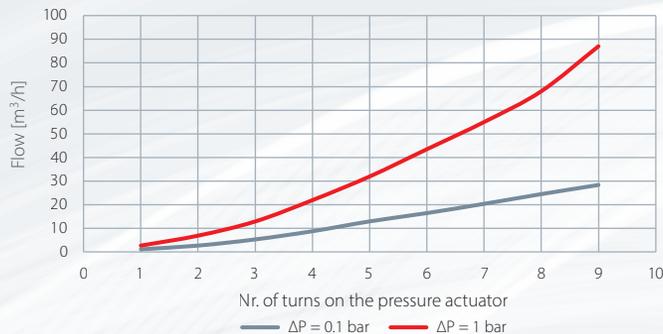
### Easy installation, commissioning & maintenance

#### Optimal network design & low investment costs with new compact pressure and flow controllers

Compact chamber balanced design and multiple installation positions can help **to save for up to 20% of the installation space** and help to design the network more optimally. No tool flow adjustment, easy flow/ $\Delta p$  setting and visible indication means trouble free commissioning and setting where operational parameters are always under control.

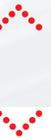
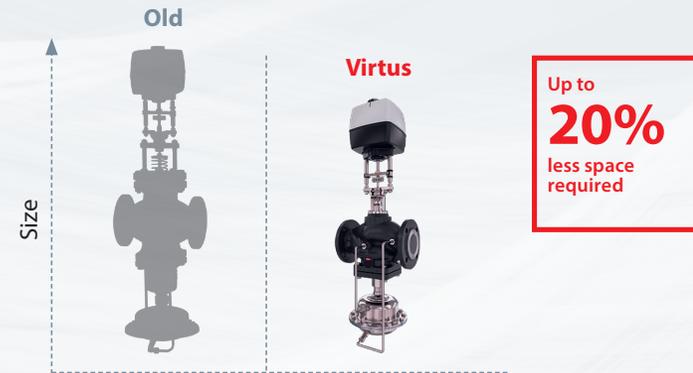
Trouble free installation, commissioning, adjustment and operation will result **in reduced installation, maintenance and operational costs.**

Flow variation depending on  $\Delta p$  setting



**300:1**  
control ratio

Compact size



# Virtus product range overview and characteristics

The Virtus portfolio contains a wide variety of high quality heavy-duty valves and pressure actuators for different applications. The valves are available in dimensions DN65 up to DN250 in PN 16, 25 and 40. The pressure actuators available in different setting ranges between 0.1 and 16 bar.

	Differential pressure control	Flow control	Differential pressure and flow control	Differential pressure control with max flow limitation	Pressure relief control		Pressure reduction
	(P)	(Q)	(PQ)	(PB, PB-F)	(A, PA)		(D)
<b>Type of control</b>							
<b>Product type</b>	AFP 2+ VFG 22(221) <sup>1)</sup>	AFQ 2 + VFG 22(221) <sup>1)</sup>	AFPQ 2(4) + VFG 22(221) <sup>1)</sup>	AFPB 2+ VFG 22(221) <sup>1)</sup>	AFA 2 + VFG 22(221) <sup>1)</sup>	AFPA 2 + VFG 22(221) <sup>1)</sup>	AFD 2 + VFG 22(221) <sup>1)</sup>
<b>PN [bar]</b>	16/25/40	16/25/40	16/25/40	16/25/40	16/25/40	16/25/40	16/25/40
<b>DN [mm]</b>	65-250	65-250	65-250	65-250	65-250	65-250	65-250
<b>Setting range <math>\Delta p</math> control / p reduction [bar]</b>	0.1-5	-	0.2-1.5	PB: 0.1-1.5 PB-F: 0.2 or 0.5 fixed	0.1-16	0.1-6	0.1-16
<b>Range of max. flow setting [m<sup>3</sup>/h]</b>	-	28-500	28-500	28-500	-	-	-
<b>Kvs [m<sup>3</sup>/h]</b>	60-800	60-800	60-800	60-800	60-800	60-800	60-800
<b>Max <math>\Delta p_v</math> [bar]</b>	10-20	10-20	10-20	10-20	10-20	10-20	10-20
<b>Max temperature [°C]</b>	150	150	150	150	150	150	150
<b>Mounting options</b>	Flow and return	Flow and return	Flow and return	Return	Bypass	Bypass	Flow
<b>Recommended control valve + actuator</b>	PN16/25: VFM2 + AME 65x PN40: VFG2 + AME65x	PN16/25: VFM2 + AME 65x PN40: VFG2 + AME65x	PN16/25: VFM2 + AME 65x PN40: VFG2 + AME65x	PN16/25: VFM2 + AME 65x PN40: VFG2 + AME65x			
	<a href="#">Go to datasheet &gt;</a>	<a href="#">Go to datasheet &gt;</a>	<a href="#">Go to datasheet &gt;</a>	<a href="#">Go to datasheet &gt;</a>	<a href="#">Go to datasheet &gt;</a>	<a href="#">Go to datasheet &gt;</a>	<a href="#">Go to datasheet &gt;</a>

<sup>1)</sup> VFG/VFG 22 metal sealing cone; VFG /VFG 221 soft sealing cone



## >> Virtus product range overview and characteristics

Besides the Virtus valves and pressure actuators the portfolio also offers heavy-duty Pressure independent control valves. These combine the differential pressure controller and separate control valve into one compact solution. The valves are available in dimensions DN65 up to DN250 in PN 16, 25 and 40.

	Pressure independent control valve with flow limiter	Pressure independent control valve with flow limiter - variable setting
	(QM)	(QMP)
		 
<b>Type of control</b>		
<b>Product type</b>	AFQM 2	AFQMP 2
<b>PN [bar]</b>	16/25/40	16/25/40
<b>DN [mm]</b>	65-250	65-250
<b>Setting range <math>\Delta p</math> control / p reduction [bar]</b>	0.2 or 0.5 fixed	0.1-1.0
<b>Range of max. flow setting [m<sup>3</sup>/h]</b>	28-500	27-630
<b>Kvs [m<sup>3</sup>/h]</b>	-	-
<b>Max <math>\Delta p_v</math> [bar]</b>	10-20	10-20
<b>Max temperature [°C]</b>	150	150
<b>Mounting options</b>	Flow and return	Flow and return
<b>Recommended actuator</b>	AME 65x	AME 65x
	<a href="#">Go to datasheet &gt;</a>	<a href="#">Go to datasheet &gt;</a>



### Revolutionary

AFQMP 2 is a revolutionary new solution in the market of heavy-duty pressure and flow controllers. It is a pressure independent control valve that also allows for adjustments of differential pressure between 0.1 and 1.0 bar. With this valve, you can achieve more precise and lower flows, as well higher capacities and bigger flows compared to traditional solutions.

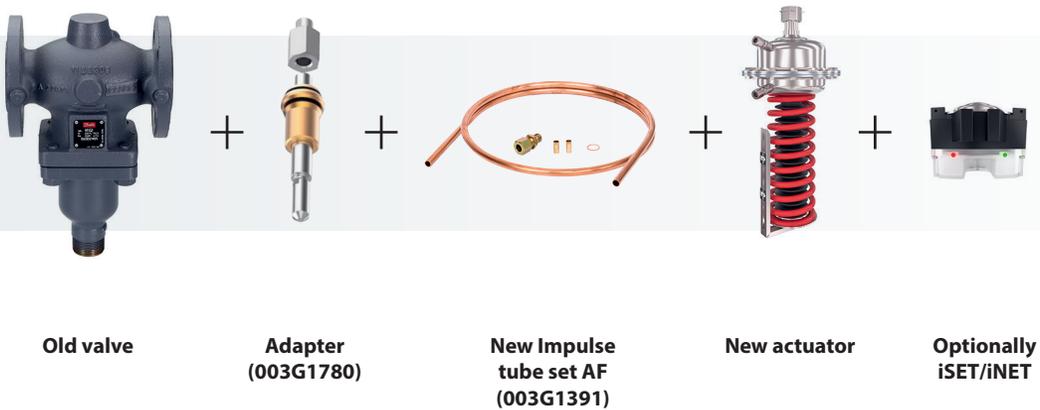
It offers adaptability to exactly meet actual needs, resulting in optimized pumping costs, lower operational costs and increased comfort. When combined with ISET or INET, it can continuously optimize performance by autonomously or remotely adjusting settings based on the actual application's requirements.



# Virtus retrofit solution with existing valves

## Low-impact retrofit solution

In case the replacement of the valves is challenging or undesirable, a retrofit option is available. The existing Danfoss valve body can remain at its current position. With a special adapter and new impulse tube(s), it's possible to mount a new pressure actuator for improved functionality. Most of the pressure actuators can also be utilized for digital optimization with iSET or iNET (see next pages).



Upgrade to new generation						
(old) Valve	Adapter	Impulse tube set AF		(new) Pressure actuator	iSET	iNET
<b>VFG 2(1)</b> 	<b>Adapter (003G1780)</b> 	<b>Impulse tube (003G1391)</b> 	2x	<b>AFP 2</b> 	●	●
			1x	<b>AFA 2</b> 	●	●
			2x	<b>AFP A 2</b> 	●	●
			1x	<b>AFD 2</b> 	●	●
<b>VFQ 2</b> 	<b>Adapter (003G1780)</b> 	<b>Impulse tube (003G1391)</b> 	2x	<b>AFQ 2</b> 	●	●
			3x	<b>AFPQ 2</b> 	●	●
			2x	<b>AFP B 2</b> 	●	●





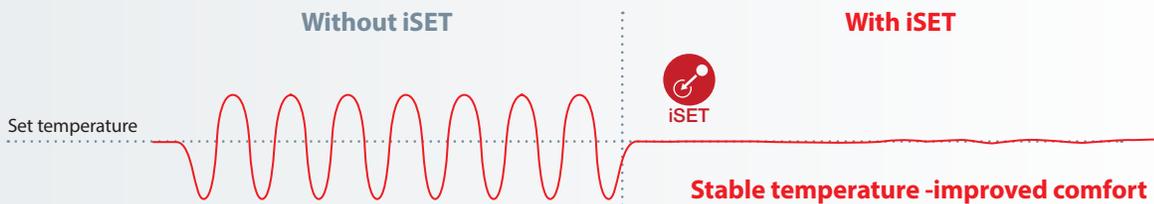
# Digital optimization **iSET**

## Intelligent substation efficiency optimization with iSET

$\Delta T$  optimization without oscillations

Intelligent iSET eliminates the temperature fluctuations in the building connected to district energy network by automatic adjustment of differential pressure ( $\Delta p$ ) over the motorized control valve (MCV) in substation. Control valve then operates in optimal mode which reflects in precise and stable temperature at consumer and longer lifetime of equipment.

### Temperature at consumer



### Benefits of iSET:

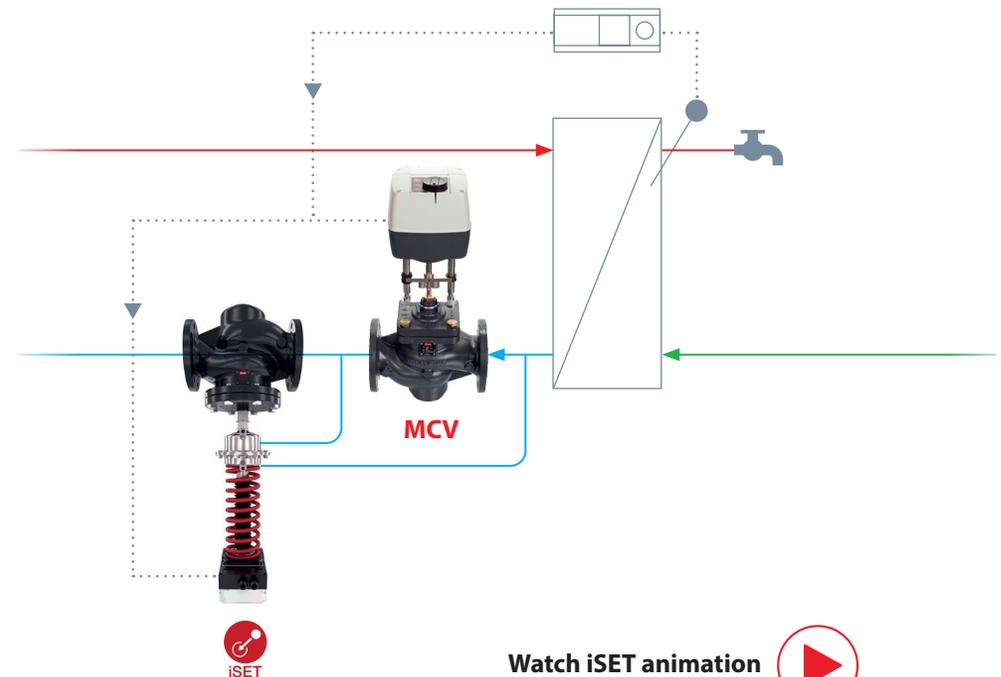
- Lower return temperature on primary network side
- Perfect balance of temperature and flow in a real-time mode
- Stable temperature-improved comfort for consumers
- Reduced operational cost for energy provider, especially in dynamic DHC systems
- Longer lifetime of installed equipment

### How auto stabilization function works

Monitors control signal level

▶ In case of oscillating signal and low MCV opening, iSET adjusts the  $\Delta p$  over the MCV

▶ MCV operates at bigger valve openings





# Digital optimization **iNET**

## Intelligent network balancing with iNET

Pumping cost reduction and peak load management

Intelligent iNET remote network balancing function enables remote  $\Delta p$  adjustment at the single branch level. This is the solution for continually changing heat consumption which requires changes in heat distribution. In order to provide optimal input for the pumps,  $\Delta p$  should be optimized at each branch. The remote control can, for example, be established with Danfoss [Leanheat® Monitor](#) and [ECL controller](#).

### Benefits of iNET:

- Lower pumping costs
- Easier operators work due to remotely controlled controllers
- Automatically resolved problems with critical points shift

### How remote pressure setting works

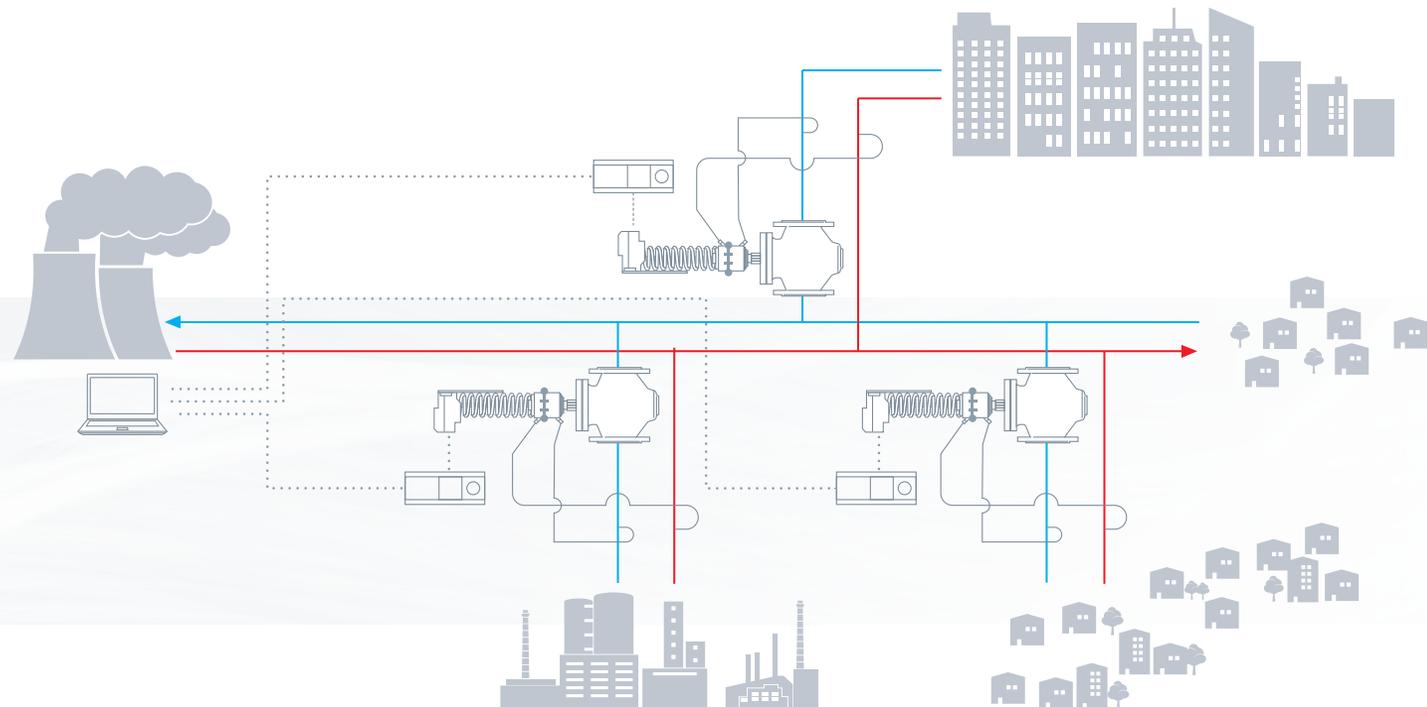
in Leanheat® Monitor or alternative SCADA system you set the required  $\Delta p$  value



The signal is transferred to iNET via the gateway/electronic controller



iNET performs physical change by squeezing or stretching the spring and with that changing the  $\Delta p$  setting



Watch iNET animation



# Network optimization with iSET and iNET

Maximize energy production and improve network efficiency

Optimize  $\Delta T$ , minimize production and distribution cost and provide best quality of supply with state-of-the-art iSET and iNET intelligent actuators.

## Remote intelligent substation **SET**ting

iSET digital actuator possess autonomous function which ensures stable temperature even in the most demanding operating conditions. iSET observes the MCV's (Motorized Control Valve) modulating control- or feedback signal, and if oscillations occur iSET reacts to them by adapting the set differential pressure values. As such it is appropriate for substation optimization, benefiting the user in terms of comfort, lower energy consumption, lower return temperature and longer equipment lifetime.

## Remote intelligent **NET**work balancing

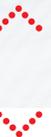
iNET digital actuator possess remote accessibility function which give you ability to remotely set the pressure setting according to actual needs throughout the network. By doing so you can adapt to daily peaks and seasonal changes. This enables optimal heat distribution and pump optimization. As such, iNET is appropriate for network optimization, by placing it to the branches that would benefit from continuous pressure adjustments. It gives you remote access when connected to different SCADA systems such as Danfoss Leanheat® Monitor, through different electronic controllers such as Danfoss ECL Comfort 310.

iSET and iNET intelligent actuators for combination with AFP/D/A/PA/PQ/PB 2 and AFQMP 2			
			
AMEi 6 <b>iSET</b> el. actuator 230 V 082G4300	AMEi 6 <b>iSET</b> el. actuator 24 V 082G4301	AMEi 6 <b>iNET</b> el. actuator 230 V 082G4302	AMEi 6 <b>iNET</b> el. actuator 24 V 082G4303
Intelligent actuator with <b>iSET</b> function		Intelligent actuator with <b>iNET</b> function	
<a href="#">Go to datasheet &gt;</a>		<a href="#">Go to datasheet &gt;</a>	

Watch the iSET function animation



Watch the iNET function animation



# End-to-end digital optimization for district energy

Danfoss is offering you a full range of solutions for optimal operation of your district energy network. Having a long tradition in producing reliable control equipment such as electronic controllers ECL, motorized control valves, self-acting controllers etc. We understand the need for digitalization and have developed the software suite Leanheat® that allows optimization of heat source, network, users and monitoring of various parameters throughout the network.

We are pioneers in dynamic hydronic balancing, for which iSET and iNET are critical solutions. They complete our portfolio and are an interlink between our software solutions and before mentioned control equipment. Furthermore, iNET is also indispensable part of Danfoss Titan™ digital twin technology for ultimate network resilience and energy efficiency achieved by continuous optimization of substation.

## Read more here:

➤ [Virtus with iSET and iNET](#)

➤ [BIM Tool and libraries](#)

➤ [Titan™ digital twin](#)

➤ [District energy webinars, articles and whitepapers](#)

➤ [Leanheat® software suite & services](#)

➤ [District energy case stories](#)



Let's  
**unlock  
the grid**



Let's start the dialogue at  
**#GreenCitiesSayHI**

## Green cities say HI!

Hydronic Intelligence™ (or HI!™) by Danfoss is an innovative approach to heating and cooling systems in residential and commercial buildings as well as district energy. It seamlessly integrates smart technology and advanced controls to optimize energy efficiency and user comfort. Using intelligent algorithms and precise monitoring, Hydronic Intelligence™ ensures hydronic systems adapt dynamically to changing conditions, reducing energy waste and enhancing overall performance.

### Danfoss A/S

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