TORAY
Innovation by Chemistry

Microfiltration Membrane

Sanitary element for dairy and food processing

Toray's Microfiltration (TMF-series) membrane separation is a low-pressure process with a molecular weight cut-off (MWCO) of between 200,000–1,000,000 Daltons.

TMF-series models are net-wrapped (no tail) spiral-wound elements incorporating a polyvinylidene fluoride (PVDF) asymmetric membrane. They are designed to remove residual fat from whey and whey protein concentrate and maximizing whey protein transmission.

Product Specifications

Model	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
WHEY DEFATTING*		
TMF 3838D1N2	0.046 (1.17)	60 (5.6)
TMF 6338D1N1	0.031 (0.79)	232 (21.6)
TMF 6338D1N2	0.046 (1.17)	188 (17.5)
TMF 6438D1N2	0.046 (1.17)	188 (17.5)
TMF 7838D1N1	0.031 (0.79)	389 (36.1)
TMF 7838D1N2	0.046 (1.17)	258 (24.0)
TMF 8038D1N1	0.031 (0.79)	392 (36.4)
TMF 8038D1N2	0.046 (1.17)	310 (28.8)
CASEIN SEPARATION**		
TMF 3838D2N2	0.046 (1.17)	60 (5.6)
TMF 6338D2N2	0.046 (1.17)	188 (17.5)
TMF 6438D2N2	0.046 (1.17)	188 (17.5)
TMF 8038D2N2	0.046 (1.17)	300 (27.9)

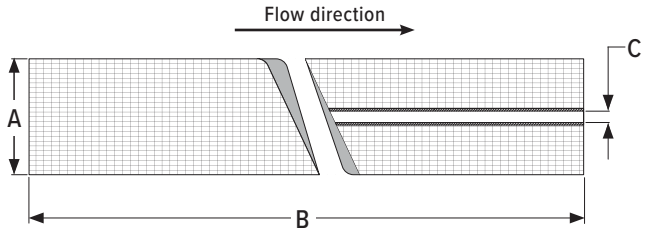
* TMF 'D1' membranes have a MWCO of 500k–1,000K Daltons
** TMF 'D2' membranes have a MWCO of 200k–400k Daltons

If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

Standard dimensions in. (mm)

Size	A Diameter	B Length	C Permeate tube ID
3838	3.8 (97)	38 (965)	0.83 (21.1)
6338	6.3 (160)	38 (965)	1.138 (28.9)
6438	6.4 (161)	38 (965)	1.138 (28.9)
7838	7.7 (196)	38 (965)	1.125 (28.6)
8038	7.9 (201)	38 (965)	1.125 (28.6)

Spiral Elements in Sanitary Design (no ATD)
Components conform to FDA Regulation CFR Title 21 and USDA/3A Sanitary Standards



Material Specifications

Feed spacer & element outer wrap	Polypropylene
Permeate carrier	Proprietary
Adhesives	Proprietary

03-TMUS-MB3-08-220926

OPERATING LIMITS

Maximum operating pressure	120 psi (8.3 bar)
Maximum operating temperature	131°F (55°C)
Maximum cleaning temperature	122°F (50°C)
Acceptable operating pH range	2.5–10.0
Acceptable short-term cleaning pH range	1.7–11.5
Maximum pressure drop per element	20 psi (1.3 bar)
Maximum pressure drop per vessel	60 psi (4.1 bar)

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE

Chlorine tolerance (short-term cleaning at pH 11)	180 ppm*
H_2O_2 continuous	Tolerant
H_2O_2 short-term cleaning <77°F (25°C)	Tolerant

**Chlorine tolerance, continuous injection is 2 ppm; chlorine tolerance, sanitizing is 50 ppm*

Applications

TMF-series 'D1' membranes

- Whey defatting
- Whey protein isolate

TMF-series 'D2' membranes

- Casein concentrate
- Brine clarification

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

NOTICE

1. Elements are preserved in sodium meta-bisulfite. Appropriate personal protective equipment should be worn when handling.
2. Toray accepts no responsibility for results obtained by the application of this information or the safety or suitability of Toray's products, either alone or in combination with other products. Users are advised to make their own tests to determine the safety and suitability of each product combination for their own purposes.
3. All data may change without prior notice, due to technical modifications or production changes.
4. Consult Toray for element sizes not shown.

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www.water.toray/products/specialty

TORAY
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10K Ultrafiltration Membrane

Sanitary element for dairy and food processing

Toray's 10K Ultrafiltration (TUF-series) membranes have a molecular weight cut-off (MWCO) of 10,000 Daltons. TUF-series models are net-wrapped (no tail), spiral-wound elements using a hydrophilic polyethersulfone (PES) asymmetric membrane specifically developed to retain milk and whey proteins, and maximize productivity.

Product Specifications

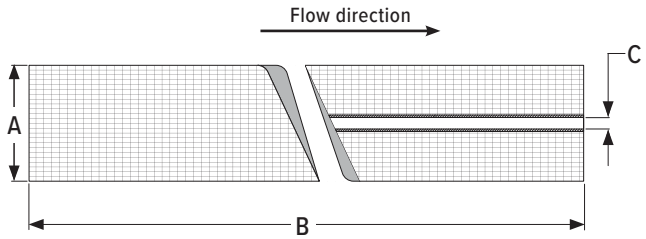
Model	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
TUF 3838N1	0.031 (0.79)	73 (6.8)
TUF 3838N2	0.046 (1.17)	57 (5.3)
TUF 3838N3	0.065 (1.65)	43 (4.0)
TUF 4333N1	0.031 (0.79)	84 (7.8)
TUF 4333N2	0.046 (1.17)	76 (7.0)
TUF 4336N1	0.031 (0.79)	91 (8.5)
TUF 4336N2	0.046 (1.17)	64 (5.9)
TUF 6338N1	0.031 (0.79)	233 (21.6)
TUF 6438N1	0.031 (0.79)	233 (21.6)
TUF 6338N2	0.046 (1.17)	176 (16.4)
TUF 6438N2	0.046 (1.17)	176 (16.4)
TUF 6338N3	0.065 (1.65)	137 (12.7)
TUF 6438N3	0.065 (1.65)	137 (12.7)
TUF 7838N1	0.031 (0.79)	343 (31.9)
TUF 8038N1	0.031 (0.79)	360 (33.4)
TUF 8038N2	0.046 (1.17)	280 (26.0)

Standard dimensions in. (mm)

Size	A Diameter	B Length	C Permeate tube ID
3838	3.8 (97)	38 (965)	0.83 (21.1)
4333	4.3 (109)	33 (838)	0.83 (21.1)
4336	4.3 (109)	35.5 (902)	0.83 (21.1)
6338	6.3 (160)	38 (965)	1.138 (28.9)
6438	6.4 (161)	38 (965)	1.138 (28.9)
7838	7.7 (196)	38 (965)	1.125 (28.6)
8038	7.9 (201)	38 (965)	1.125 (28.6)

Spiral Elements in Sanitary Design (no ATD)

Components conform to FDA Regulation CFR Title 21 and USDA/3A Sanitary Standards



Material Specifications

Feed spacer & element outer wrap	Polypropylene
Permeate carrier	Proprietary
Adhesives	Proprietary

If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

03-TMUS-MB3-06-240510

10K Ultrafiltration Membrane
Product datasheet

TORAY
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OPERATING LIMITS

Maximum operating pressure	140 psi (9.7 bar)
Maximum operating temperature	131°F (55°C)
Maximum cleaning temperature	122°F (50°C)
Acceptable operating pH range	2.5–10.0
Acceptable short-term cleaning pH range	1.7–11.5
Maximum pressure drop per element	15 psi (1.0 bar)
Maximum pressure drop per vessel	60 psi (4.1 bar)

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE

Chlorine tolerance (short-term cleaning at pH 11)	180 ppm*
H_2O_2 continuous	Tolerant
H_2O_2 short-term cleaning <77°F (25°C)	Tolerant

**Chlorine tolerance, continuous injection is 2 ppm; chlorine tolerance, sanitizing is 50 ppm*

Applications

Toray's TUF-series 10K membranes offer high flux and protein retention ideal for whey processing at all concentrations and milk protein concentration (MPC) applications. Toray's TUF-series 10K HR (High-Rejection) membranes yield high protein retention for high concentration end of whey and whey protein isolate (WPI) plants.

- Lactose free milk
- Milk protein isolate
- White cheeses
- Soft cheeses
- Whey protein concentrate (WPC 35-85)
- Whey protein isolate (WPI-90)
- Whey permeate concentrate

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

NOTICE

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4. Consult Toray for element sizes not shown.

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03-TMUS-MB3-06-240510

TORAY
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5K Ultrafiltration Membrane

Sanitary element for dairy and food processing

Toray's 5K Ultrafiltration (TUF-series) membranes provide a molecular weight cut-off of 5,000 Daltons. TUF-series models are net-wrapped (no tail), spiral-wound elements using a hydrophilic polyethersulfone (PES) asymmetric membrane specifically developed for maximum retention of milk and whey proteins and maximum productivity. 'HR' models incorporate a low flux membrane with maximum retention for special applications in the production of dairy, gelatin, sugar, and more.

Product Specifications

Model	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
TUF5 3838N1 / TUF5 3838HRN1	0.031 (0.79)	73 (6.8)
TUF5 3838N2 / TUF5 3838HRN2	0.046 (1.17)	57 (5.3)
TUF5 4336N2	0.046 (1.17)	64 (5.9)
TUF5 6338N1 / TUF5 6338HRN1 / TUF5 6338HRN1T*	0.031 (0.79)	233 (21.6)
TUF5 6338N2 / TUF5 6338HRN2 / TUF5 6338N2T*	0.046 (1.17)	176 (16.4)
TUF5 6338N3 / TUF5 6338HRN3	0.065 (1.65)	137 (12.7)
TUF5 6338HRN4	0.080 (2.03)	35 (3.3)
TUF5 6438N1 / TUF5 6438HRN1	0.031 (0.79)	233 (21.6)
TUF5 6438N2 / TUF5 6438HRN2	0.046 (1.17)	176 (16.4)
TUF5 6438N3 / TUF5 6438HRN3	0.065 (1.65)	137 (12.7)
TUF5 6438HRN4	0.080 (2.03)	35 (3.3)
TUF5 7838N2	0.046 (1.17)	330 (30.6)
TUF5 8038N1 / TUF5 8038HRN1	0.031 (0.79)	360 (33.4)
TUF5 8038N2 / TUF5 8038HRN2	0.046 (1.17)	280 (26.0)
TUF5 8038N3 / TUF5 8038HRN3	0.065 (1.65)	230 (21.4)

***T** indicates a tail that can be trimmed

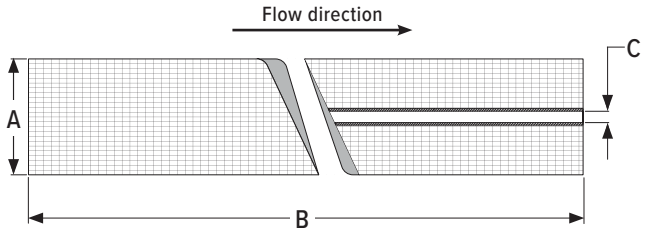
If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

Standard dimensions in. (mm)

Size	A Diameter	B Length	C Permeate tube ID
3838	3.8 (97)	38 (965)	0.83 (21.1)
6338	6.3 (160)	38 (965)	1.138 (28.9)
6438	6.3 (161)	38 (965)	1.138 (28.9)
8038	7.9 (201)	38 (965)	1.125 (28.6)

Spiral Elements in Sanitary Design (no ATD)

Components conform to FDA Regulation CFR Title 21 and USDA/3A Sanitary Standards



Material Specifications

Feed spacer & element outer wrap	Polypropylene
Permeate carrier	Proprietary
Adhesives	Proprietary

5K Ultrafiltration Membrane
Product datasheet

TORAY
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OPERATING LIMITS

Maximum operating pressure	140 psi (9.7 bar)
Maximum operating temperature	131°F (55°C)
Maximum cleaning temperature	122°F (50°C)
Acceptable operating pH range	2.5–10.0
Acceptable short-term cleaning pH range	1.7–11.5
Maximum pressure drop per element	15 psi (1.0 bar)
Maximum pressure drop per vessel	60 psi (4.1 bar)

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE

Chlorine tolerance (short-term cleaning at pH 11) ppm	180 ppm*
H_2O_2 continuous	Tolerant
H_2O_2 short-term cleaning <77°F (25°C)	Tolerant

**Chlorine tolerance, continuous injection is 2 ppm; chlorine tolerance, sanitizing is 50 ppm*

Applications

Toray's TUF-series 5K membranes offer extra high retention of proteins, fats, and polysaccharides. TUF-series 5K HR (High-Rejection) membranes are ideal for maximum retention of organic molecules for special applications in dairy production, gelatin, sugar, and more.

- Lactose free milk
- Milk protein isolate
- White cheeses
- Soft cheeses
- Whey protein concentrate (WPC 35-85)
- Whey protein isolate (WPI-90)

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

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TORAY
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Nanofiltration Membrane

Sanitary element for dairy and food processing

Toray's Nanofiltration (TNF-series & TMNF-series) membrane elements incorporate a piperazine amide composite membrane specifically designed for maximum retention of sugars and proteins, and high passage of monovalent salt ions.

Product Specifications

Model	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
TNF 3838N1	0.031 (0.79)	75 (7.0)
TNF 3838N2	0.046 (1.17)	63 (5.9)
TNF 3840N1	0.031 (0.79)	75 (7.0)
TNF 7838N1	0.031 (0.79)	365 (33.9)
TNF 7838N2	0.046 (1.17)	276 (25.6)
TNF 8038N1	0.031 (0.79)	375 (34.8)
TNF 8038N2	0.046 (1.17)	310 (28.8)
TMNF 8040PS	0.031 (0.79)	375 (34.8)

If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

Material Specifications

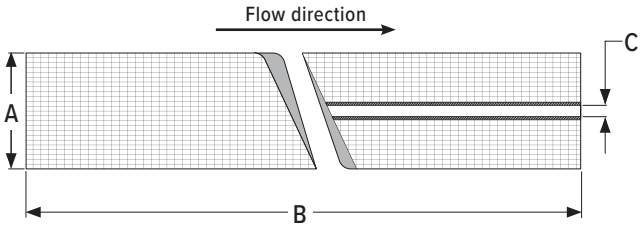
Feed spacer & element outer wrap	Polypropylene
Permeate tubes, Anti-telescoping device (ATD), inter-connectors for TMNF models	Polysulfone
Permeate carrier	Proprietary
Adhesives	Proprietary

Standard dimensions in. (mm)

Size	A Diameter	B Length	C Permeate tube ID
3838	3.8 (97)	38 (965)	0.83 (21.1)
3840	3.8 (97)	38.75 (984)	0.83 (21.1)
7838	7.7 (196)	38 (965)	1.125 (28.6)
8038	7.9 (201)	38 (965)	1.125 (28.6)
8040	7.9 (201)	40 (1,016)	1.125 (28.6)

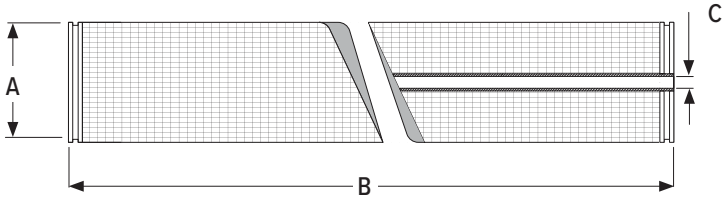
Spiral Elements in Sanitary Design (no ATD)

Components conform to FDA Regulation CFR Title 21 and USDA/3A Sanitary Standards



TMRO 8040 models (w/ ATD)

Components conform to FDA Regulation CFR Title 21



OPERATING LIMITS

Maximum operating pressure	800 psi (55.2 bar)
Maximum operating temperature	122°F (50°C)
Maximum cleaning temperature	122°F (50°C)
Acceptable operating pH range	3.5–10.5
Acceptable short-term cleaning pH range	1.8–11.5
Maximum pressure drop per element	15 psi (1.0 bar)
Maximum pressure drop per vessel	60 psi (4.1 bar)

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE

Chlorine tolerance (short-term cleaning at pH 11)	Non-detect
H_2O_2 continuous **ppm**	20*
H_2O_2 short-term cleaning <77°F (25°C) **ppm**	1,000*

**Free chlorine should not be present in feed*

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

Applications

Ideal applications include the desalting of milk and whey products (removal of monovalent ions) and to maximize the retention of lactose and larger organic molecules.

- Whey protein isolate
- Demineralized whey
- Lactose concentration
- Lactose-free milk
- Water recovery
- Sugar concentration
- Flavor concentration
- Wine de-alcoholization
- Beer de-alcoholization
- Diafiltration water

NOTICE

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03-TMUS-MB3-05-220926

TORAY
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Reverse Osmosis Membrane

Sanitary element for dairy and food processing

Toray's sanitary reverse osmosis (TRO-series and TMRO-series) products are high-rejection fully cross-linked aromatic polyamide composite membrane in a sanitary net wrap design.

Product Specifications

Model	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
REVERSE OSMOSIS		
TRO 3838N1	0.031 (0.79)	77 (7.2)
TRO 3838N2	0.046 (1.17)	60 (5.6)
TRO 3838N3	0.065 (1.65)	46 (4.3)
TRO 3839N1	0.031 (0.79)	77 (7.2)
TRO 7838N1	0.031 (0.79)	380 (35.3)
TRO 7838N2	0.046 (1.17)	310 (28.8)
TRO 8038N1	0.031 (0.79)	390 (36.2)
TRO 8038N2	0.046 (1.17)	320 (29.7)
TRO 8038N3	0.065 (1.65)	240 (22.3)
TMRO 8040PS	0.031 (0.79)	390 (36.2)
HIGH-PRESSURE REVERSE OSMOSIS		
TRO 3838HP	0.031 (0.79)	77 (7.2)
TRO 8038HP	0.031 (0.79)	390 (36.2)
TRO 8038HPN2	0.046 (1.17)	312 (29.0)
TMRO 8040HP	0.031 (0.79)	390 (36.2)
TMRO 8040HPN2	0.046 (1.17)	312 (29.0)

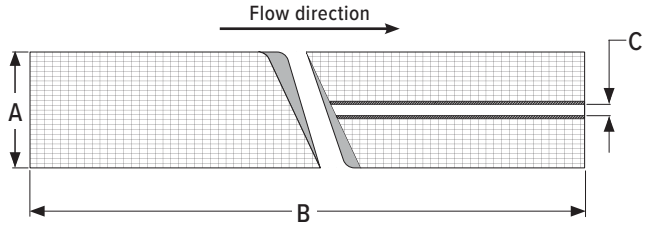
If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

Standard dimensions in. (mm)

Size	A Diameter	B Length	C Permeate tube ID
3838	3.8 (97)	38 (965)	0.83 (21.1)
3839	3.8 (97)	38.75 (984)	0.83 (21.1)
7838	7.7 (196)	38 (965)	1.125 (28.6)
8038	7.9 (201)	38 (965)	1.125 (28.6)
8040	7.9 (201)	40 (1,016)	1.125 (28.6)

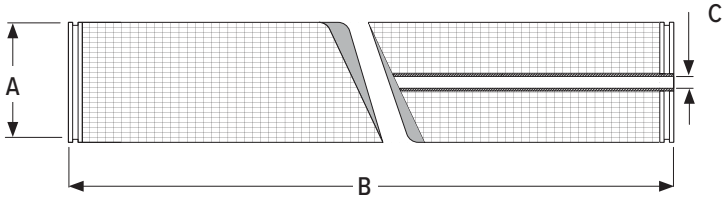
Spiral Elements in Sanitary Design (no ATD)

Components conform to FDA Regulation CFR Title 21 and USDA/3A Sanitary Standards



TMRO 8040 models (w/ ATD)

Components conform to FDA Regulation CFR Title 21



Material Specifications

Feed spacer & element outer wrap	Polypropylene
Permeate tubes, Anti-telescoping device (ATD), inter-connectors for TMNF models	Polysulfone
Permeate carrier	Proprietary
Adhesives	Proprietary

03-TMUS-MB3-04-240618

OPERATING LIMITS

Maximum operating pressure	800 psi (55.2 bar)
Maximum operating temperature	122°F (50°C)
Maximum operating temperature for HPRO	150°F (65°C)*
Maximum cleaning temperature	122°F (50°C)
Acceptable operating pH range	2.5–10.5
Acceptable short-term cleaning pH range	1.7–11.5
Maximum pressure drop per element	15 psi (1.0 bar)
Maximum pressure drop per vessel	60 psi (4.1 bar)

** Please refer to conditioning procedures on pg. 2 of this document*
Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE

Chlorine tolerance (short-term cleaning at pH 11)	Non-detect
H_2O_2 continuous **ppm**	20*
H_2O_2 short-term cleaning <77°F (25°C) **ppm**	1,000*

**Free chlorine should not be present in feed*

Membrane characteristics

TRO-series elements are ideal for maximum retention of valuable milk solids and COD/BOD contributing compounds.

TRO-series HP elements are high-rejection.

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

Applications

- Milk permeate concentrate
- Sugar concentration
- Flavor concentration
- Aroma concentration
- Wine de-alcoholization
- Beer de-alcoholization
- Diafiltration water

Conditioning procedure for TRO-series HP elements when operating above 50°C

New Toray high-pressure reverse osmosis membrane elements intended for operation at temperatures above 122°F (50°C) must be pre-conditioned before initial use by exposure to hot water at low pressure. Conditioning water must be high-quality chlorine and oxidant free, non-scaling, non-fouling water. RO permeate is preferred (water from an RO that has been in operation for at least 24 hours).

Conditioning procedure:

1. Flush water to drain with a non-scaling water at low pressure, maintaining low permeate rates.
2. Recycle warm water 104–113°F (40–45°C) at less than 25 psi (1.7 bar) trans-membrane pressure. The maximum differential pressure is 2 psi (0.13 bar) per element or 10 psi (0.69 bar) per vessel.
3. Introduce hot water to the circulating system to increase temperature to 140–150°F (60–65°C).
4. Maintain this temperature and a TMP less than 25 psi (1.7 bar) for 80 minutes.
5. The maximum temperature increase or decrease is 2° C/ (3.6° F) minute.
6. Allow the circulating system to cool below 113°F (45°C) or below.

NOTICE

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3. All data may change without prior notice, due to technical modifications or production changes.
4. Consult Toray for element sizes not shown.

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www.water.toray/products/specialty

TORAY
Innovation by Chemistry

Hygienic Purified Water Membrane

For food, beverage, pharmaceutical, polisher, and heat sanitizable applications

Toray's Sanitary UF, Sanitary RO, and Heat Sanitizable RO membrane elements provide superior permeate quality for hygienic purified water applications. RO elements use a cross-linked fully aromatic polyamide composite membrane.

Product Specifications

Model	NaCl rejection % / MWCO (Daltons)	Permeate flow rate GPD (m^3/d)	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
HEAT-SANITIZABLE RO				
TMRO 8040HS	99.5%	9,000* (34.1)	0.028 (0.71)	400 (37.2)
TMRO 4040HS	99.5%	1,975* (7.5)	0.028 (0.71)	85 (7.9)
NET-WRAPPED RO & UF**				
TMRO 8040PS	99.5%	9,000 (34.1)	0.031 (0.79)	390 (36.2)
TMUF5 8040PS	5,000		0.031 (0.79)	370 (34.4)

**Target flow rate after heat conditioning*
***Elements are not heat-sanitizable*

Test Conditions

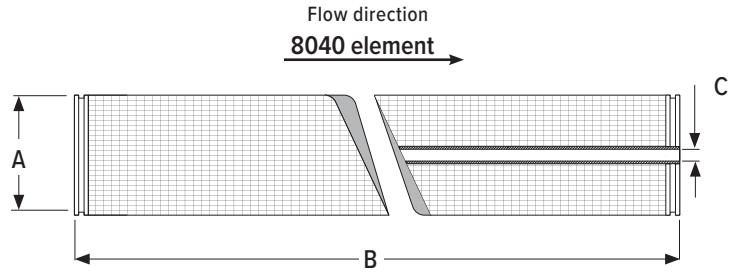
Feed water pressure psi (bar)	**TMRO HS**	150 (10.3)
	TMRO 8040PS	225 (15.5)
Feed water temperature °F (°C)		77 (25)
Feed water concentration mg/l as NaCl		2,000
Recovery rate %		15
Feed water pH		7

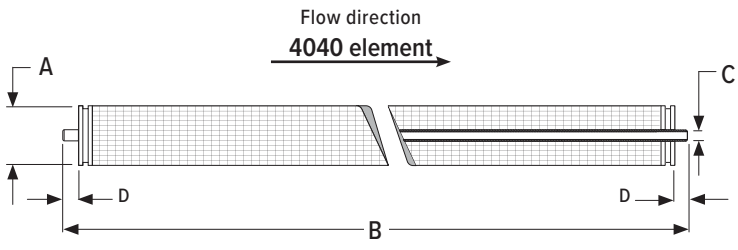
If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

Dimensions in. (mm)

	4040	8040	Size
A	3.90 (99)	7.9 (201)	**Diameter**
B	40 (1,016)	40 (1,016)	**Length**
C	0.75 (19) OD	1.125 (29) ID	**Permeate Tube**
D	1.06 (27)	—	

Hygienic purified water elements (w/ ATD)
Components conform to FDA Regulation CFR Title 21





Material Specifications

Feed spacer & element outer wrap	**Heat-Sanitizable RO**	Polyethylene
	Net-wrapped RO/UF	Polypropylene
Permeate tubes, Anti-telescoping device (ATD), inter-connectors		Polysulfone
Permeate carrier		Proprietary
Adhesives		Proprietary

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OPERATING LIMITS	TMRO HS	TMRO PS	TMUF PS
Maximum operating pressure **psi (bar)**	600 (41.4)	800 (55.2)	200 (13.8)
Maximum sanitizing temperature **°F (°C)**	185 (85)	122 (50)	131 (55)
Maximum operating temperature **°F (°C)**	113 (45)	122 (50)	131 (55)
Maximum cleaning temperature **°F (°C)**	122 (50)	122 (50)	122 (50)
Acceptable operating pH range	2.0–11.0	2.5–10.5	2.5–10.0
Acceptable short-term cleaning pH range	1.7–11.5	1.7–11.5	1.7–11.5
Maximum pressure drop per element **psi (bar)**	15 (1.0)	15 (1.0)	15 (1.0)
Maximum pressure drop per vessel **psi (bar)**	60 (4.1)	60 (4.1)	60 (4.1)

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE			
Chlorine tolerance, continuous injection **ppm**	Non-detect*	Non-detect*	2
Chlorine tolerance, sanitizing **ppm**			50
Maximum chlorine concentration (CIP) **ppm**			180 at pH 11
H_2O_2 continuous **ppm**	20*	20*	Tolerant
H_2O_2 short-term cleaning <77°F (25°C) **ppm**	1,000*	1,000*	Tolerant

**Free chlorine should not be present in feed*

operation for at least 24 hours).

Conditioning procedure:

1. Flush water to drain with non-scaling water at low pressure, maintaining low permeate rates.
2. Recycle warm water 40–45°C at less than 25 psig (1.7 bar) trans-membrane pressure (TMP). The maximum differential pressure is 2 psi per element or 10 psi per vessel.
3. Introduce hot water to the circulating system to increase the temperature to 175–185°F (80–85°C).
4. Maintain this temperature and a TMP less than 25 psig (1.7 Bar) for 80 minutes.
5. Allow the circulating system to cool to 113°F (45°C).
6. The maximum temperature increase or decrease is 2° C/minute.
7. Flush to drain with clean water maintaining a TMP of <25 psi and a maximum feed pressure of 45 psi (3 bar).
8. Factory pre-conditioned HSRO elements are available. Contact Toray for details.

Applications

- Food & beverage
- Pharmaceutical (water for injection)
- Diafiltration
- Sugar concentration
- Flavor concentration
- Aroma concentration
- Wine de-alcoholization
- Beer de-alcoholization

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

Heat Sanitization

Toray HSRO-series elements are sanitized with hot water as the preferred method in food and pharmaceutical applications eliminating the need for chemicals and other disposals.

New Toray HSRO-series elements must be pre-conditioned prior to initial use by exposure to hot water. Conditioning water must be high-quality chlorine and oxidant free, non-scaling, non-fouling water. RO permeate is preferred (water from an RO that has been in

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TORAY
Innovation by Chemistry

Heat Sanitizable Membrane

For applications requiring hot water sanitization eliminating sanitization by chemicals.

Toray's Heat Sanitizable RO membrane elements provide superior permeate quality for hygienic purified water applications. RO elements use a cross-linked fully aromatic polyamide composite membrane.

Product Specifications

Model	NaCl rejection %	Permeate flow rate GPD (m^3/d)	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
TMRO 8040HS	99.5%	9,000* (34.1)	0.028 (0.71)	400 (37.2)
TMRO 4040HS	99.5%	1,975* (7.5)	0.028 (0.71)	85 (7.9)

**Target flow rate after heat conditioning*

Test Conditions

Feed water pressure psi (bar)	150 (10.3)
Feed water temperature °F (°C)	77 (25)
Feed water concentration mg/l as NaCl	2,000
Recovery rate %	15
Feed water pH	7

If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

Dimensions in. (mm)

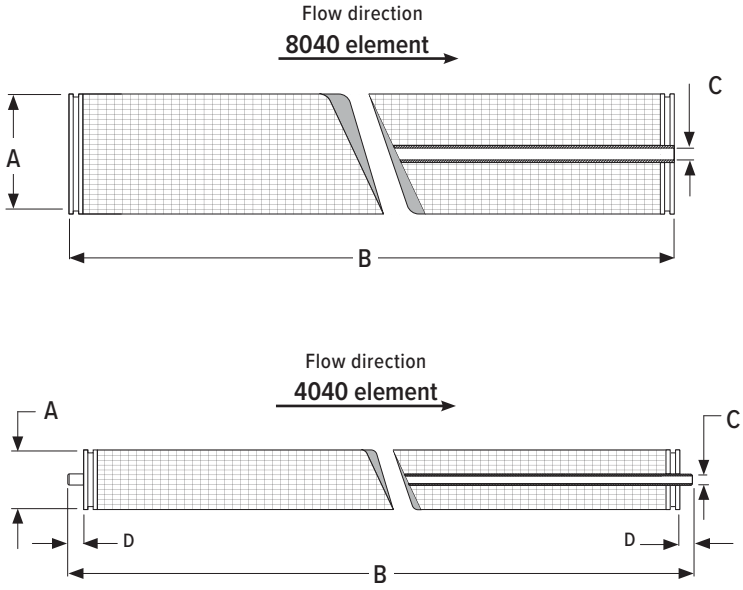
	4040	8040	Size
A	3.90 (99)	7.9 (201)	**Diameter**
B	40 (1,016)	40 (1,016)	**Length**
C	0.75 (19) OD	1.125 (29) ID	**Permeate Tube**
D	1.06 (27)	—	

Material Specifications

Feed spacer & element outer wrap	Polyethylene
Permeate tubes, Anti-telescoping device (ATD), inter-connectors	Polysulfone
Permeate carrier	Proprietary
Adhesives	Proprietary

Heat-sanitizable elements (w/ ATD)

Components conform to FDA Regulation CFR Title 21



OPERATING LIMITS

Maximum operating pressure **psi (bar)**	**600 (41.4)**
Maximum sanitizing temperature **°F (°C)**	**185 (85)**
Maximum operating temperature **°F (°C)**	**113 (45)**
Maximum cleaning temperature **°F (°C)**	**122 (50)**
Acceptable operating pH range	**2.0–11.0**
Acceptable short-term cleaning pH range	**1.7–11.5**
Maximum pressure drop per element **psi (bar)**	**15 (1.0)**
Maximum pressure drop per vessel **psi (bar)**	**60 (4.1)**

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE

Chlorine tolerance (short-term cleaning at pH 11)	**Non-detect**
H_2O_2 continuous **ppm**	**20***
H_2O_2 short-term cleaning <77°F (25°C) **ppm**	**1,000***

**Free chlorine should not be present in feed*

Conditioning procedure:

1. Flush water to drain with non-scaling water at low pressure, maintaining low permeate rates.
2. Recycle warm water 40–45°C at less than 25 psig (1.7 bar) trans-membrane pressure (TMP). The maximum differential pressure is 2 psi per element or 10 psi per vessel.
3. Introduce hot water to the circulating system to increase the temperature to 175–185°F (80–85°C).
4. Maintain this temperature and a TMP less than 25 psig (1.7 Bar) for 80 minutes.
5. Allow the circulating system to cool to 113°F (45°C).
6. The maximum temperature increase or decrease is 2° C/minute.
7. Flush to drain with clean water maintaining a TMP of <25 psi and a maximum feed pressure of 45 psi (3 bar).
8. Factory pre-conditioned HSRO elements are available. Contact Toray for details.

Applications

- Food & beverage
- Pharmaceutical (water for injection)
- Diafiltration
- Sugar concentration
- Flavor concentration
- Aroma concentration
- Wine de-alcoholization
- Beer de-alcoholization

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

Heat Sanitization

Toray HSRO-series elements are sanitized with hot water as the preferred method in food and pharmaceutical applications eliminating the need for chemicals and other disposals.

New Toray HSRO-series elements must be pre-conditioned prior to initial use by exposure to hot water. Conditioning water must be high-quality chlorine and oxidant free, non-scaling, non-fouling water. RO permeate is preferred (water from an RO that has been in

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TORAY
Innovation by Chemistry

Pre-Conditioned Heat-Sanitizable Membranes

For hygienic purified water applications

Toray's Pre-Conditioned Heat Sanitizable RO membrane elements provide superior permeate quality for sustainable hygienic purified water applications. RO elements use a cross-linked fully aromatic polyamide composite membrane.

Product Specifications

Model	NaCl rejection %	Permeate flow rate GPD (m^3/d)	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
TMRO 8040HSX	99.5%	9,000 (34.1)	0.028 (0.71)	400 (37.2)
TMRO 4040HSX	99.5%	1,975 (7.5)	0.028 (0.71)	85 (7.9)

Test Conditions

Feed water pressure	150 psi (10.3 bar)
Feed water temperature	77°F (25°C)
Feed water concentration	2,000 mg/l as NaCl
Recovery rate	15%
Feed water pH	7

Dimensions in. (mm)

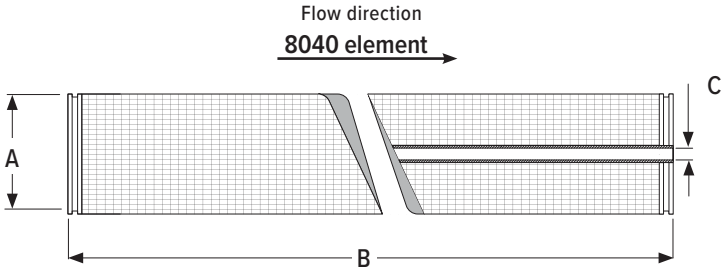
	4040	8040	Size
A	3.90 (99)	7.9 (201)	**Diameter**
B	40 (1,016)	40 (1,016)	**Length**
C	0.75 (19) OD	1.125 (29) ID	**Permeate Tube**
D	1.06 (27)	—	

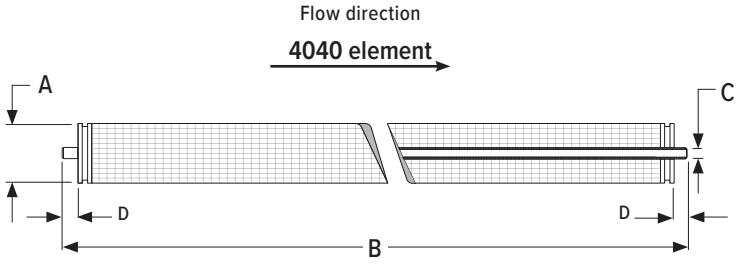
Material Specifications

Feed spacer	Polyethylene
Element outer wrap	Polypropylene
Permeate tubes, Anti-telescoping device (ATD), inter-connectors	Polysulfone
Permeate carrier	Proprietary
Adhesives	Proprietary

Heat-sanitizable elements (w/ ATD)

Components conform to FDA Regulation CFR Title 21





OPERATING LIMITS

Maximum operating pressure	600 psi (41.0 bar)
Maximum sanitizing temperature	185°F (85°C)
Maximum operating temperature	113°F (45°C)
Maximum cleaning temperature	122°F (50°C)
Acceptable operating pH range	2.0–11.0
Acceptable short-term cleaning pH range	1.7–11.5
Maximum pressure drop per element	15 psi (1.0 bar)
Maximum pressure drop per vessel	60 psi (4.1 bar)
Maximum chlorine tolerance (free chlorine)	N/D

Consult Toray for pressure limits when operating above ambient temperature

Important

- The maximum temperature for continuous operation above pH 10 is 95^{0}F (35^{0}C).
- High temperature elements have been pre-conditioned at 80^{0}C.
- Take precautions to ensure that the trans-membrane pressure is kept below 25 psi (1.7 bar).
- Maximum sanitizing dP per element is 2 psi (0.14 bar), with a maximum vessel dP of 10 psi (0.7 bar).
- Elements should be allowed to cool below 113 ^{0}F (<45 ^{0}C) before changing pressures or concentrations for operation following sanitization.
- The maximum temperature increase or decrease is 2° C/minute.

Applications

- Food & beverage
- Pharmaceutical (water for injection)

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

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TORAY
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Hygienic Purified Water Membrane

For clean industrial, pharmaceutical, polisher, and heat sanitizable applications

Toray's Sanitary UF, Sanitary NF, Sanitary RO, and Heat Sanitizable RO membrane elements provide superior permeate quality for hygienic purified water applications. RO elements use a cross-linked fully aromatic polyamide composite membrane.

Product Specifications

Model	NaCl rejection % / MWCO (Daltons)	Permeate flow rate GPD (m^3/d)	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
HEAT-SANITIZABLE RO				
TMRO 8040HS	99.5%	9,000* (34.1)	0.028 (0.71)	400 (37.2)
TMRO 4040HS	99.5%	1,975* (7.5)	0.028 (0.71)	85 (7.9)
NET-WRAPPED ELEMENTS**				
TMRO 8040PS	99.5%	9,000 (34.1)	0.031 (0.79)	390 (36.2)
TMRO(D) 8040PS	99.5%	9,000 (34.1)	0.031 (0.79)	390 (36.2)
TMRO 8040HP	99.8%		0.031 (0.79)	390 (36.2)
TMRO 8040HPN2	99.8%		0.031 (0.79)	312 (29.0)
TMNF 8040PS	–	–	0.031 (0.79)	375 (34.8)
TMUF5 8040PS	5,000	–	0.031 (0.79)	370 (34.4)

**Target flow rate after heat conditioning*
***Elements are not heat-sanitizable*

Test Conditions

Feed water pressure psi (bar)	TMRO HS	150 (10.3)
	TMRO 8040PS	225 (15.5)
	TMRO 8040HP	800 (55.2)
Feed water temperature °F (°C)		77 (25)
Feed water concentration mg/l as NaCl	TMRO HS; TMRO 8040PS	2,000
	TMRO 8040HP	32,000
Recovery rate %	TMRO HS; TMRO 8040PS	15
	TMRO 8040HP	8
Feed water pH	TMRO HS; TMRO 8040PS	7
	TMRO 8040HP	8

If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

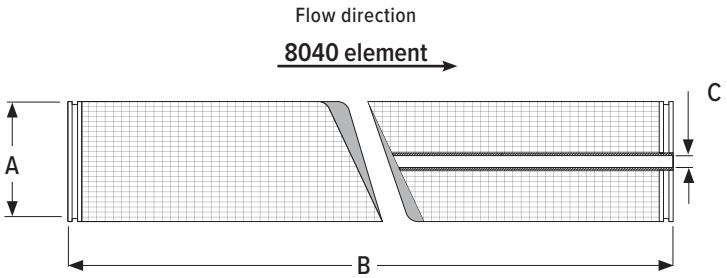
Dimensions in. (mm)

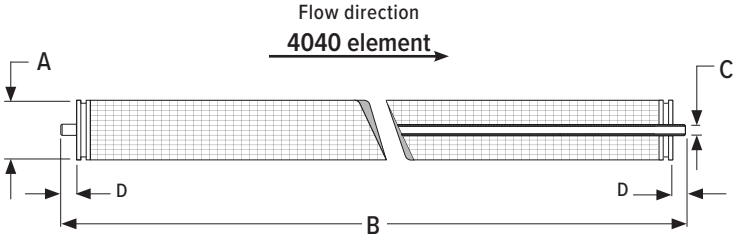
	4040	8040	Size
A	3.90 (99)	7.9 (201)	Diameter
B	40 (1,016)	40 (1,016)	Length
C	0.75 (19) OD	1.125 (29) ID	Permeate Tube
D	1.06 (27)	—	

Material Specifications

Feed spacer & element outer wrap	Heat-Sanitizable RO	Polyethylene
	Net-wrapped RO/UF	Polypropylene
Permeate tubes, Anti-telescoping device (ATD), inter-connectors		Polysulfone
Permeate carrier		Proprietary
Adhesives		Proprietary

Hygienic purified water elements (w/ ATD)
Components conform to FDA Regulation CFR Title 21





OPERATING LIMITS	TMRO HS	TMRO HP	TMRO PS	TMNF PS	TMUF PS
Maximum operating pressure **psi (bar)**	600 (41.4)	800 (55.2)	800 (55.2)	800 (55.2)	200 (13.8)
Maximum operating temperature **°F (°C)**	113 (45)	150 (65)	122 (50)	122 (50)	131 (55)
Maximum cleaning temperature **°F (°C)**	122 (50)	122 (50)	122 (50)	122 (50)	122 (50)
Acceptable operating pH range	2.0–11.0	2.5–10.5	2.5–10.5	3.5–10.5	2.5–10.0
Acceptable short-term cleaning pH range	1.7–11.5	1.7–11.5	1.7–11.5	1.8–11.5	1.7–11.5
Maximum pressure drop per element **psi (bar)**	15 (1.0)	15 (1.0)	15 (1.0)	15 (1.0)	15 (1.0)
Maximum pressure drop per vessel **psi (bar)**	60 (4.1)	60 (4.1)	60 (4.1)	60 (4.1)	60 (4.1)

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE					
Chlorine tolerance, continuous injection **ppm**	Non-detect*	Non-detect*	Non-detect*	Non-detect*	2
Chlorine tolerance, sanitizing **ppm**					50
Maximum chlorine concentration (CIP) **ppm**					180 at pH 11
H_2O_2 continuous **ppm**	20*	20*	20*	20*	Tolerant
H_2O_2 short-term cleaning <77°F (25°C) **ppm**	1,000*	1,000*	1,000*	1,000*	Tolerant

**Free chlorine should not be present in feed*

Conditioning procedure for HSRO elements:

1. Flush water to drain with non-scaling water at low pressure, maintaining low permeate rates.
2. Recycle warm water 40–45°C at less than 25 psig (1.7 bar) trans-membrane pressure (TMP). The maximum differential pressure is 2 psi per element or 10 psi per vessel.
3. Introduce hot water to the circulating system to increase the temperature to 175–185°F (80–85°C).
4. Maintain this temperature and a TMP less than 25 psig (1.7 Bar) for 80 minutes.
5. Allow the circulating system to cool to 113°F (45°C).
6. The maximum temperature increase or decrease is 2° C/minute.
7. Flush to drain with clean water maintaining a TMP of <25 psi and a maximum feed pressure of 45 psi (3 bar).
8. Factory pre-conditioned HSRO elements are available. Contact Toray for details.

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Heat Sanitization

Toray HSRO-series elements are sanitized with hot water as the preferred method in food and pharmaceutical applications eliminating the need for chemicals and other disposals.

New Toray HSRO-series elements must be pre-conditioned prior to initial use by exposure to hot water. Conditioning water must be high-quality chlorine and oxidant free, non-scaling, non-fouling water. RO permeate is preferred (water from an RO that has been in operation for at least 24 hours).

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TORAY
Innovation by Chemistry

Heat Sanitizable Membrane

For sanitary applications requiring hot water sanitization eliminating sanitization by chemicals.

Toray's sanitary Heat Sanitizable RO membrane elements provide superior permeate quality for dairy and food processing applications. RO elements use a cross-linked fully aromatic polyamide composite membrane in a sanitary net wrap design.

Product Specifications

Model	Feed spacer thickness in. (mm)	Active area ft^2 (m^2)
TRO 3838HSN1	0.031 (0.79)	77(70.2)
TRO 8038HSN1	0.031 (0.79)	390 (36.2)

If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is ready to develop custom engineered solutions. Please inquire within.

Test Conditions

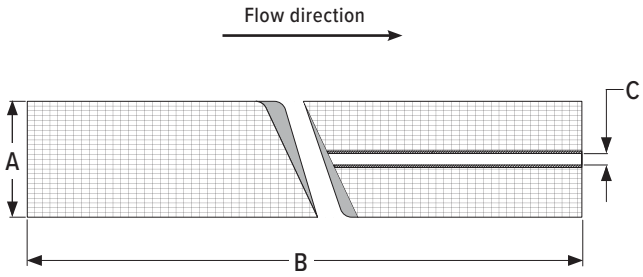
Feed water pressure psi (bar)	150 (10.3)
Feed water temperature °F (°C)	77 (25)
Feed water concentration mg/l as NaCl	2,000
Recovery rate %	15
Feed water pH	7

Dimensions in. (mm)

	3838	8038	Size
A	3.8 (97)	7.9 (201)	**Diameter**
B	38 (965)	38 (965)	**Length**
C	0.83 (21.1) ID	1.125 (29) ID	**Permeate Tube**

Spiral Elements in Sanitary Heat Sanitizable Design (no ATD)

Components conform to FDA Regulation CFR Title 21 and USDA/3A Sanitary Standards



Material Specifications

Feed spacer & element outer wrap	Polypropylene
Permeate tubes, Anti-telescoping device (ATD), inter-connectors	Polysulfone
Permeate carrier	Proprietary
Adhesives	Proprietary

OPERATING LIMITS

Maximum operating pressure **psi (bar)**	**600 (41.4)**
Maximum sanitizing temperature **°F (°C)**	**185 (85)**
Maximum operating temperature **°F (°C)**	**113 (45)**
Maximum cleaning temperature **°F (°C)**	**122 (50)**
Acceptable operating pH range	**2.5–10.5**
Acceptable short-term cleaning pH range	**1.7–11.5**
Maximum pressure drop per element **psi (bar)**	**15 (1.0)**
Maximum pressure drop per vessel **psi (bar)**	**60 (4.1)**

Consult Toray for pressure limits when operating above ambient temperature

OXIDANT TOLERANCE

Chlorine tolerance (short-term cleaning at pH 11)	**Non-detect**
H_2O_2 continuous **ppm**	**20***
H_2O_2 short-term cleaning <77°F (25°C) **ppm**	**1,000***

**Free chlorine should not be present in feed*

Conditioning procedure:

1. Flush water to drain with non-scaling water at low pressure, maintaining low permeate rates.
2. Recycle warm water 40–45°C at less than 25 psig (1.7 bar) trans-membrane pressure (TMP). The maximum differential pressure is 2 psi per element or 10 psi per vessel.
3. Introduce hot water to the circulating system to increase the temperature to 175–185°F (80–85°C).
4. Maintain this temperature and a TMP less than 25 psig (1.7 Bar) for 80 minutes.
5. Allow the circulating system to cool to 113°F (45°C).
6. The maximum temperature increase or decrease is 2° C/minute.
7. Flush to drain with clean water maintaining a TMP of <25 psi and a maximum feed pressure of 45 psi (3 bar).
8. Factory pre-conditioned HSRO elements are available. Contact Toray for details.

Applications

- Food & beverage
- Pharmaceutical (water for injection)
- Diafiltration
- Sugar concentration
- Flavor concentration
- Aroma concentration
- Wine de-alcoholization
- Beer de-alcoholization

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

Heat Sanitization

Toray HSRO-series elements are sanitized with hot water as the preferred method in food and pharmaceutical applications eliminating the need for chemicals and other disposals.

New Toray HSRO-series elements must be pre-conditioned prior to initial use by exposure to hot water. Conditioning water must be high-quality chlorine and oxidant free, non-scaling, non-fouling water. RO permeate is preferred (water from an RO that has been in

NOTICE

1. Elements are preserved in sodium meta-bisulfite. Appropriate personal protective equipment should be worn when handling.
2. Toray accepts no responsibility for results obtained by the application of this information or the safety or suitability of Toray's products, either alone or in combination with other products. Users are advised to make their own tests to determine the safety and suitability of each product combination for their own purposes.
3. All data may change without prior notice, due to technical modifications or production changes.
4. Consult Toray for element sizes not shown.

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TORAY
Innovation by Chemistry

TMRO-TS Series

Heat-Sanitizable Brackish Water Reverse Osmosis Membrane Element

Toray's Heat Sanitizable RO membrane elements provide superior permeate quality for high purity applications. Using heat sanitization eliminates the need for chemical sanitization, further reducing maintenance costs. RO elements use cross-linked fully aromatic polyamide composite membranes.

Product Specifications	Unit	TMRO-G10TS	TMRO-G20FTS
Size		4040	8040
Membrane Area	ft^2 (m^2)	75 (7.0)	400 (37.2)
Nominal Salt Rejection	%	99.5	99.5
Minimum Salt Rejection	%	99.0	99.0
Product Flow Rate	gpd (m^3/d)	1,300 (5.0)	9,500 (36.0)

Test Conditions: Feed water pressure 150 psi (1.03 MPa); Feed water temperature 25°C (77 °F); Feed water concentration 2,000 mg/L as NaCl; Recovery rate 15%; Feed water pH 7.
*Specified performance values are post heat conditioning

Applications

High purity water generation, Industrial process water

Dimensions in. (mm)		
Size	4040	8040
A	4.0 (101)	7.9 (201)
B	40 (1,016)	40 (1,016)
C	0.75 (19)	1.125 (29)
D	1.05 (26)	

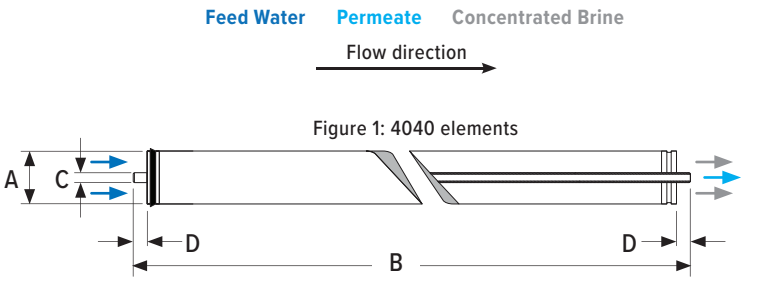

Figure 1: 4040 elements

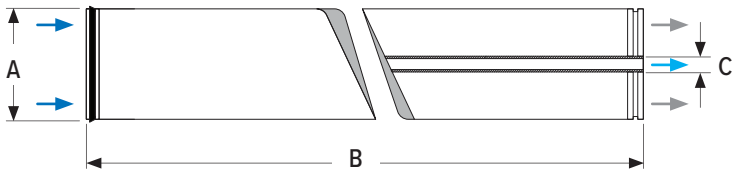

Figure 2: 8040 elements

TMRO-TS Series

Heat-Sanitizable Brackish Water Reverse Osmosis Membrane Element

OPERATING LIMITS	G10TS	G20FTS
Maximum operating pressure **psi (bar)**	600 (41.4)	
Maximum sanitizing temperature **°F (°C)**	185 (85)	
Maximum operating temperature **°F (°C)**	113 (45)	
Maximum cleaning temperature **°F (°C)**	122 (50)	
Acceptable operating pH range	3.0–9.0	
Acceptable short-term cleaning pH range	2.0–11.0	
Maximum pressure drop per element **psi (bar)**	15 (1.0)	
Maximum pressure drop per vessel **psi (bar)**	30 (2.0)	
Maximum feed turbidity	<4	
Feed flow rate per vessel l/min (gpm)	<50 (13)	<200 (52.8)
Brine flow rate per vessel l/min (gpm)	>10 (2.6)	>40 (10.6)

Consult Toray for pressure limits when operating above ambient temperature

Conditioning procedure:

1. Flush water to drain with non-scaling water at low pressure, maintaining low permeate rates.
2. Recycle warm water 40–45°C at less than 25 psig (1.7 bar) trans-membrane pressure (TMP). The maximum differential pressure is 2 psi per element or 10 psi per vessel.
3. Introduce hot water to the circulating system to increase the temperature to 175–185°F (80–85°C).
4. Maintain this temperature and a TMP less than 25 psig (1.7 Bar) for 80 minutes.
5. Allow the circulating system to cool to 113°F (45°C).
6. The maximum temperature increase or decrease is 2° C/minute.
7. Flush to drain with clean water maintaining a TMP of <25 psi and a maximum feed pressure of 45 psi (3 bar).

Regulatory Information

Toray's membrane elements are certified under:

- ISO 9001:2015 QMS to ensure consistency in product and service quality; and
- ISO 14001:2015 EMS to enhance the environmental performance of our products and services.

Heat Sanitization

Toray TMRO-TS-series elements are sanitized with hot water as the preferred method in food and pharmaceutical applications eliminating the need for chemicals and other disposals.

Sanitization must follow guidelines in Toray's membrane manuals on our website (www.water.toray)

NOTICE

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2. All data may change without prior notice, due to technical modifications or production changes.
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www.water.toray/products/specialty