

MEMBRANE FILTRATION

RO | NF | UF | MF



Spiral-wound **RO, NF, UF, MF** membrane elements in sanitary design for dairy foods processing and hygienic purified water applications

PRODUCT BROCHURE

'TORAY'

Innovation by Chemistry

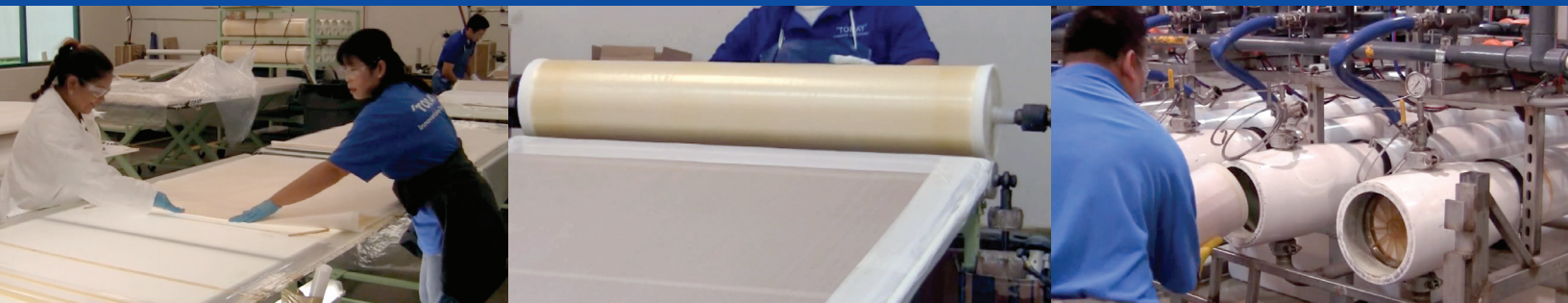
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Toray manufactures **RO**, **NF**, **UF** and **MF** membrane elements in sanitary design for dairy and hygienic purified water applications.

TORAY MEMBRANE USA, INC. (TMUS), located in San Diego, California, manufactures membrane elements in sanitary design for processing of dairy foods and purifying water required for various industrial processes. Finished goods are also stocked in Germany by Toray Membrane Europe AG (TMEu).

Toray maintains high-quality in our products and services through decades of R&D, manufacturing, and proven references. TMUS is an ISO 9001:2015 QMS and 14001:2015 EMS registered facility to ensure quality and compliance with environmental policies.

WWW.WATER.TORAY



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MEMBRANE DIVISION

In 1968 TORAY began our membrane development program for water treatment. Fifty years later, the name endures as a leading supplier of membrane technologies continuing to add new solutions for a sustainable future. This constant pursuit of technological innovation has enabled us to strengthen our core assets: R&D know-how, strong customer and supplier bases and the dedicated people that stand behind our products and services. To experience lasting growth, partner with a company that has, for decades, adapted to the changing needs of the market and looks to the horizon for the next big challenge.

TORAY, A NAME YOU CAN TRUST.

Toray RO

Spiral-wound reverse osmosis membrane elements with fully aromatic cross-linked polyamide composite membranes for seawater desalination, brackish water desalination, and water reuse.

Toray NF

Spiral-wound nanofiltration membrane elements and RO elements for point-of-use applications.

Toray UF







Pressurized and submerged PVDF hollow-fiber ultrafiltration modules.

Toray MBR

PVDF flat-sheet membrane bioreactor modules.

Products used for the production of potable water are certified to NSF/ANSI Standards 61 and 58 to comply with drinking water requirements.

MEMBRANE TECHNOLOGIES by TORAY

Separation Materials	Ions, low molecular weight organics		High molecular weight polymer	
			Colloids	
	THM	Agriculture & Organics	Viruses	
	Monovalents	Multivalents	Milk Protein	
psi	100 - 800 psi	75 psi	5 - 30 psi	0 - 5 psi
Type	Reverse Osmosis (RO)	Nanofiltration (NF)	Ultrafiltration (UF)	Microfiltration (MF)
Size	Dissolved Solids	Dissolved Solids	0.01 - 0.05 μm	0.05 - 0.1 μm
Toray's Membrane Technologies	Ultrapure water, Seawater desalination, Wastewater reclamation 	Softening, Removal of toxic substances 	Municipal drinking water, Water reuse, Pretreatment for seawater desalination 	Sewage water treatment 
	Toray RO	CSM	Toray UF	Toray MBR
	  Specialty Separations			

MEMBRANE FILTRATION

for DAIRY APPLICATIONS

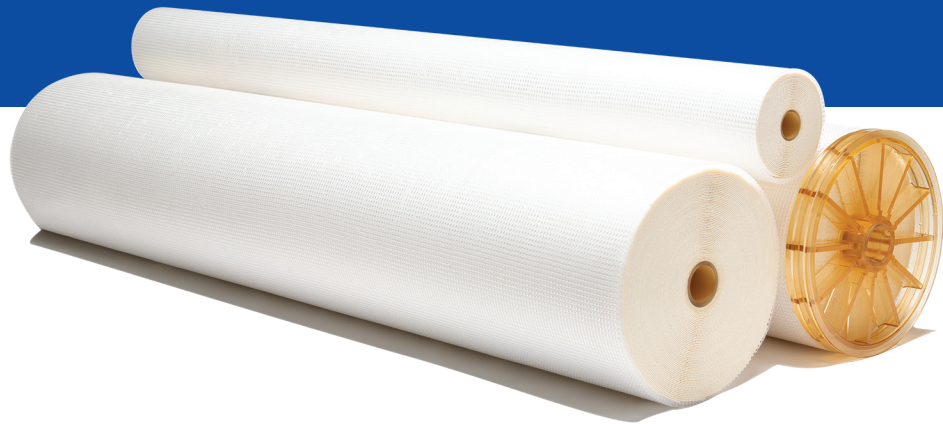
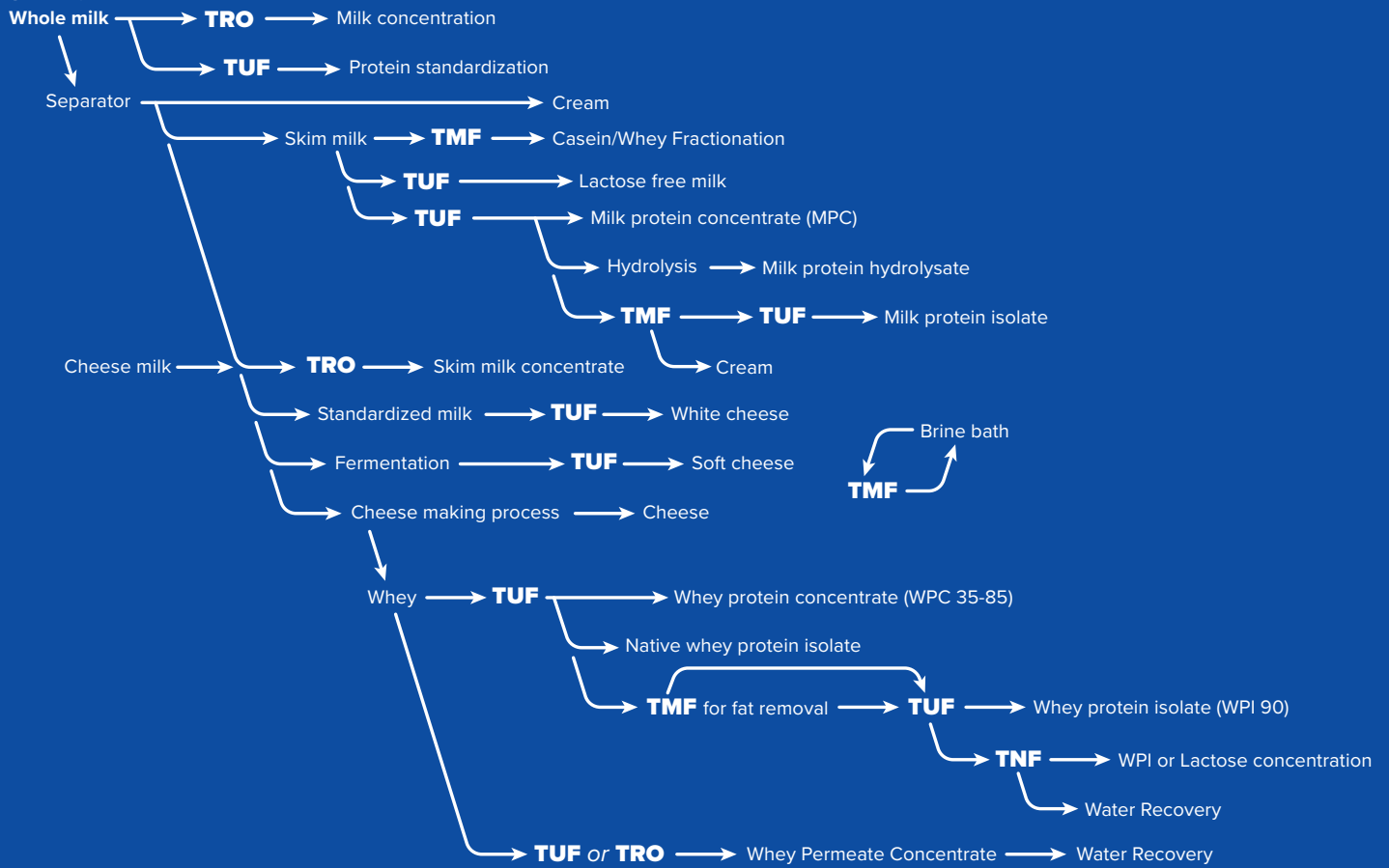
Product series Membrane characteristics

Reverse Osmosis (RO)	
TRO	Fully cross-linked aromatic polyamide composite membrane for maximum retention of valuable milk solids and COD/BOD contributing compounds.
TRO(D)	Toray's next generation 'D-family' polyamide composite membrane for increased durability.
TRO + HP	High-pressure and high-rejection polyamide composite membrane with 99.8% NaCl rejection.
Nanofiltration (NF)	
TNF	Piperazine amide composite membrane for desalting of milk and whey products and maximum retention of lactose and larger organic molecules.
Ultrafiltration (UF)	
TUF 10K	Standard UF with high flux and protein retention ideal for whey processing at all concentrations and milk protein concentration (MPC)
TUF 10KHR	High protein retention membrane with ideal flux for high concentration end of whey and whey protein isolate (WPI) plants
TUF 5K	Extra high retention membrane
TUF 5KHR	Low flux membrane with maximum retention for special applications in dairy, gelatin, sugar and more
Microfiltration (MF)	
TMF	Polyvinylidene fluoride (PVDF) for de-fatting and casein separation

Toray offers membrane products that cover the entire spectrum of filtration for the processing of dairy foods. Membrane elements are manufactured with precision and available in varying diameters, lengths, and feed spacer thicknesses to meet the specific retention of proteins, organic molecules, and other compounds needed to produce quality dairy products.



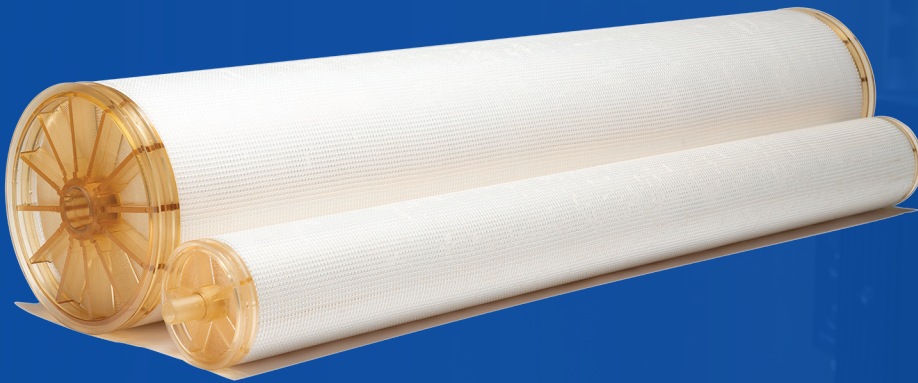
DAIRY MEMBRANE PROCESSES



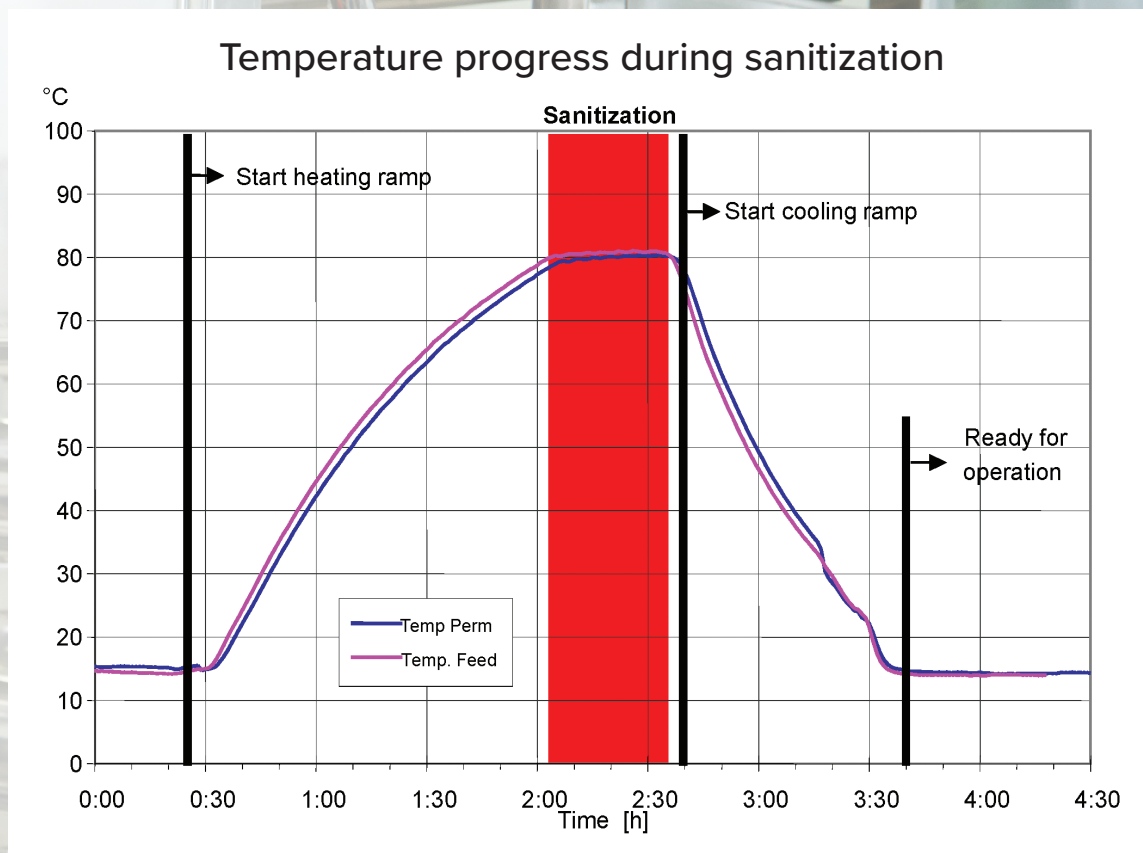
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MEMBRANE FILTRATION

for **HYGIENIC PURIFIED WATER**



Toray's manufactures membrane elements in sanitary design for applications requiring hygienic purified water such as those for the food, beverage and pharmaceutical industries. Heat-sanitizable membrane elements are treated to a maximum sanitizing temperature of 185°F (85°C). Membrane element components comply with FDA CFR Title 21.



Membrane model

Performance

Feed water conditions

Heat-sanitizable RO

TMRO 8040HS

9,000 GPD; 99.5% NaCl rejection

Pressure 150 psi (10.3 bar); Temperature 77°F (25°C);
Concentration 2,000 mg/l as NaCl; Recovery rate 15%; pH 7

TMRO 4040HS

1,975 GPD; 99.5% NaCl rejection

Net-wrapped RO & UF

TMRO 8040PS

9,000 GPD; 99.7% NaCl rejection

Pressure 225 psi (15.5 bar); Temperature 77°F (25°C);
Concentration 2,000 mg/l as NaCl; Recovery rate 15%; pH 7

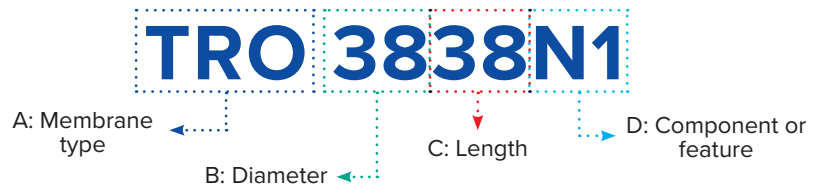
TMUF5 8040PS

5,000 Daltons MWCO

PRODUCT NOMENCLATURE

Use the following classification system for identifying membrane type, characteristics and features.

Example:



A — Membrane type	B — Diameter	C — Length	D — Component or features
TRO = Reverse osmosis	38 = 3.8 inches	33 = 33 inches	N1 = 31 mil feed spacer thickness
TRO(D) = 'D-family' reverse osmosis	40 = 4.0 inches	36 = 36 inches	N2 = 46 mil feed spacer thickness
TMRO = Reverse osmosis w/ ATD	43 = 4.3 inches	38 = 38 inches	N3 = 65 mil feed spacer thickness
TNF = Nanofiltration	63 = 6.3 inches	39 = 39 inches	N4 = 80 mil feed spacer thickness
TMNF = Nanofiltration w/ ATD	64 = 6.4 inches	40 = 40 inches	HP = High-pressure membrane
TUF = Ultrafiltration w/ 10K Dalton MWCO	78 = 7.8 inches		HR = High retention membrane
TUF5 = Ultrafiltration w/ 5K Dalton MWCO	80 = 8.0 inches		PS = Polysulfone permeate tube
TMUF5 = Ultrafiltration 5K Dalton w/ ATD			HS = Heat-sanitizable element
TMF = Microfiltration			T = Element that can be trimmed
			D1 = Whey de-fatting element
			D2 = Casein separation element

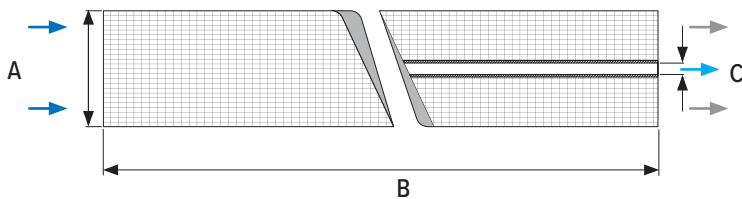
Configurations not specified with a feed "net" spacer component are standardized with 31 mil feed spacers except for "HS" elements which are constructed with a 28 mil feed spacer.

PRODUCT SPECIFICATIONS

Elements in sanitary design w/o ATD

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

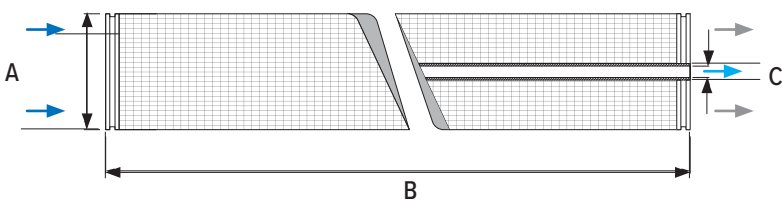
TMF, TUF, TNF, TRO elements



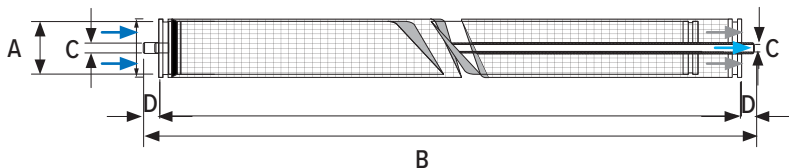
Net-Wrapped elements with ATD for hygienic purified water

Components conform to FDA Regulation CFR Title 21

8-inch TMNF, TMRO, TMUF elements



4-inch TMRO elements



STANDARD DIMENSIONS inches (mm.)

Size	A Diameter	B Length	C Permeate tube ID	D
SANITARY DESIGN ELEMENTS				
3838	3.8 (97)	38 (965)	0.83 (21.1)	
3839	3.8 (97)	38.75 (984)	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)	
NET-WRAPPED ELEMENTS WITH ATD				
4040	4.0 (102)	40 (1,016)	0.75 (19.1) OD	1.0 (26)
8040	7.9 (201)	40 (1,016)	1.125 (28.6)	

ULTRAFILTRATION w/ 10K MWCO for dairy and food processing

Model	Feed spacer thickness in. (mm)	Active area ft ² (m ²)
TUF 3838N1 / TUF 3838HRN1	0.031 (0.79)	73 (6.8)
TUF 3838N2 / TUF 3838HRN2	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 4333HRN1	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 4336HRN2	0.046 (1.17)	64 (5.9)
TUF 6338N1 / TUF 6338HRN1	0.031 (0.79)	233 (21.6)
TUF 6438N1 / TUF 6438HRN1	0.031 (0.79)	233 (21.6)
TUF 6338HRN1T	0.031 (0.79)	233 (21.6)
TUF 6338N2 / TUF 6338HRN2	0.046 (1.17)	176 (16.4)
TUF 6438N2 / TUF 6438HRN2	0.046 (1.17)	176 (16.4)
TUF 6338N2T / TUF 6338HRN2T	0.046 (1.17)	176 (16.4)
TUF 6338N3 / TUF 6338HRN3	0.065 (1.65)	137 (12.7)
TUF 6438N3 / TUF 6438HRN3	0.065 (1.65)	137 (12.7)
TUF 6338N3T / TUF 6338HRN3T	0.065 (1.65)	137 (12.7)
TUF 6338N4T	0.080 (2.03)	102 (9.5)
TUF 7838N1	0.031 (0.79)	343 (31.9)
TUF 8038N1 & TUF 8038HRN1	0.031 (0.79)	360 (33.4)
TUF 8038N2 & TUF 8038HRN2	0.046 (1.17)	280 (26.0)

ULTRAFILTRATION w/ 5K MWCO for dairy and food processing

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 6338N1 & TUF5 6338HRN1	0.031 (0.79)	233 (21.6)
TUF5 6438N1 & TUF5 6438HRN1	0.031 (0.79)	233 (21.6)
TUF5 6338N2 & TUF5 6338HRN2	0.046 (1.17)	176 (16.4)
TUF5 6438N2 & TUF5 6438HRN2	0.046 (1.17)	176 (16.4)
TUF5 6338N3 & TUF5 6338HRN3	0.065 (1.65)	137 (12.7)
TUF5 6438N3 & TUF5 6438HRN3	0.065 (1.65)	137 (12.7)
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)

MICROFILTRATION for dairy and food processing

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)	150 (13.9)
TMF 6438D2N2	0.046 (1.17)	150 (13.9)
TMF 8038D2N2	0.046 (1.17)	300 (27.9)

NANOFILTRATION for dairy and food processing

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 8040PSN1	0.031 (0.79)	375 (34.8)
TMNF 8040PSN2	0.046 (1.17)	310 (28.8)

REVERSE OSMOSIS for dairy and food processing

Model	Feed spacer thickness in. (mm)	Active area ft ² (m ²)
STANDARD RO		
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(D) 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)
TRO(D) 8038N1	0.031 (0.79)	390 (36.2)
TMRO 8040PS	0.031 (0.79)	390 (36.2)
TMRO(D) 8040PS	0.031 (0.79)	390 (36.2)
HIGH-PRESSURE RO		
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)

HYGIENIC PURIFIED WATER MEMBRANES

Model	Feed spacer thickness in. (mm)	Active area ft ² (m ²)
HEAT-SANITIZABLE RO		
TMRO 8040HS	0.028 (0.71)	400 (37.2)
TMRO 4040HS	0.028 (0.71)	85 (7.9)
NET-WRAPPED RO & UF		
TMRO 8040PS¹	0.031 (0.79)	390 (36.2)
TMUF5 8040PS²	0.031 (0.79)	370 (34.4)

¹NaCl rejection % is 99.7% and permeate flow rate is 9,000 gpd (34.1)

²MWCO is 5,000 Daltons

Heat Sanitization — for HSRO products

Toray HSRO 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 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).

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.

OPERATING LIMITS	TMF	TUF	TNF	TRO	TRO HP	TMRO HS ¹	TMRO PS	TMUF5
Max. operating pressure psi (bar)	120 (8.3)	140 (9.7)	800 (55.2)	800 (55.2)	800 (55.2)	600 (41.4)	800 (55.2)	200 (13.8)
Max. operating temperature °F (°C)	131 (55)	131 (55)	122 (50)	122 (50)	150 (65)	113 (45)	122 (50)	131 (55)
Max. cleaning temperature °F (°C)	122 (50)	122 (50)	122 (50)	122 (50)	122 (50)	122 (50)	122 (50)	122 (50)
Acceptable operating pH range	2.5–10.0	2.5–10.0	3.5–10.5	2.5–10.5	2.5–10.5	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	1.8–11.5	1.7–11.5	1.7–11.5	1.7–11.5	1.7–11.5	1.7–11.5
Max. pressure drop per element psi (bar)	20 (1.3)	15 (1.0)	15 (1.0)	15 (1.0)	15 (1.0)	15 (1.0)	15 (1.0)	15 (1.0)
Pressure drop per vessel psi (bar)	60 (4.1)	60 (4.1)	60 (4.1)	60 (4.1)	60 (4.1)	60 (4.1)	60 (4.1)	60 (4.1)
Oxidant tolerance								
Chlorine tolerance, short-term cleaning at pH 11	180 ppm ²	180 ppm ²	Non-detect	Non-detect	Non-detect	Non-detect	Non-detect	180 ppm ²
H ₂ O ₂ continuous ppm	Tolerant	Tolerant	20*	20*	20*	20*	20*	Tolerant
H ₂ O ₂ short-term cleaning <77°F (25°C) ppm	Tolerant	Tolerant	1,000*	1,000*	1,000*	1,000*	1,000*	Tolerant

Consult Toray for pressure limits when operating above ambient temperatures

*Free chlorine should not be present in feed

¹Inquire about factory pre-conditioned HSR0 elements

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

Performance / Test Conditions

Parameter / Model	TRO HP / TMRO HP	TMRO 8040HS	TMRO 4040HS
NaCl rejection rate %	99.8	99.5	99.5
Permeate flow rate GPD (m ³ /d)	–	9,000* (34.1)	1,975* (7.5)
Flux rate gfd (lmh)	17.5 (30)	–	–
Feed water pressure psi (bar)	800 (55.2)	150 (10.3)	150 (10.3)
Feed water temperature °F (°C)	77 (25)	77 (25)	77 (25)
Feed water concentration mg/L as NaCl	32,000	2,000	2,000
Recovery rate %	8	15	15
Feed water pH	8	7	7

*Target flow rate after heat conditioning



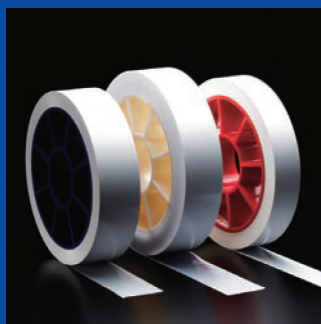
If you do not see a configuration or performance requirement that meets your needs, a team of product specialists is available to develop custom engineered solutions. Please inquire within.



Fibers & Textiles



Resins & Chemicals



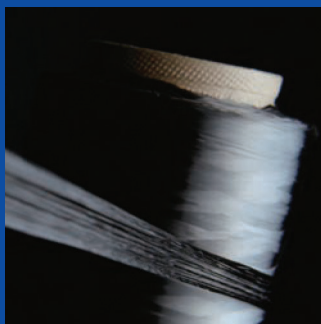
Films



Medical Products



Electronics & IT



Carbon Fiber & Composite Materials



Housing & Engineering Materials



Water Treatment & Environment

GLOBAL MATERIALS INNOVATOR

Founded in 1926, businesses of the Toray Group create innovative materials and technologies in a wide range of fields, including fibers and textiles, plastic resins & chemicals, films, carbon fiber composite materials, water treatment & environmental membrane products, and materials for the electronics & IT industries and pharmaceutical & medical fields, all under the corporate slogan **“Innovation by Chemistry.”**

TORAY Innovation by Chemistry

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