

Annex 4

Maintenance matrix

foam operations COMAH / SEVESO maintenance schedule x: nothing done yes: done N/A : not applicable, installation NOT existing				
equipment	what shall be done	frequency	additional information	specifications or checks content
unloading area	detection / checks	periodicity		
access control	check integrity	1M	for each access, a master key should be made available in a central point + list of authorized person to use the key	specifications: two options: a card key system or door with code / key . Checks: door closed and correct functioning
bunds	check integrity		bunds protected with epoxy coating	specification: equal to the biggest amount: either 100 % of the biggest tank or 50 % of associated tanks in the same bund. For example 2 x 60 tons TDI tanks, 1/ = 120 t, 2/ = 60t, capacity of the bund must be 120 tons. Resistant to the action of liquids. Fully tightened. Checks: absence of visible damage, recalculate capacity after modification
labeling	presence	12M	for each chemical + color code / instrument coding	specification: name of chemical (acronym or family name and code), flow direction, Hazard code (from GHS: very toxic or harmful) and code for valves: product code and V for valve + number). visible from the floor. Example: diisocyanates X01 => T+, valves n° 24 = X01 V24 check: presence and adequacy
Salvo system	check integrity	each operation	specs defined on BIC	see the BIC in the foam e-room
wheels clamp	check integrity	each operation		one wheel locked in both directions during unloading OR Salvo system if applicable
road tanker grounding	not necessary (ADR)			no need
piping (tanker connections)				
gaskets (flexible hose connection)	replacement periodicity + check	12M + check at each operation	regular replacement needed.	specifications: the gaskets shall be certified “compatible with diisocyanates”, with a thickness and diameter compatible with hose’s supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers’ specifications if any). presence of identifier. checks: absence of leak or external visible damage< replace: once damaged / or every year
flexible hose (liquids)	replacement periodicity + check	12M + check at each operation	regular replacement needed	specifications: the hose shall be able to resist to vacuum (> 7 meters water column) without collapsing, and to overpressure (4 bar). The hose shall be certified “compatible with diisocyanates”. The hose must be equipped with 4 screws flange connection for diisocyanates and quick connection (diameter different from water connection) for polyol. The supplier shall define a replacement date / periodicity. Based on our experience, replacement every year is a good combination (we’ve experience of hoses having at least two years without damage, once stored capped an hung). check: presence of liquid identifier, visible date of replacement and test certificate, absence of visible damage, absence of leaks, presence of gaskets.
flexible hose cap	check integrity	12M + check at each operation		specifications: the cap shall be able to resist to diisocyanates (chemical aggression as well as pressure) in case of accidental opening of the valve and must be airtight. Checks: presence and absence of damage
connections integrity	check integrity	3M	inspection once a year for 10 % of the connections, with rotation every year. In case of damage, 100 % inspection needed	specifications: see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of lead on instrument connections (pipes on liquid phase) (gauges, sampling valve, purging valve, glass sight, safety relief valves, level indicators). Special attention to be given on gaskets placed after Allweiler pumps or any pump in which a safety relief valve is placed and cannot be tested from the outside).
integrity of quick release connection	check integrity + replacement	3M + 12M	replacement needed for gaskets	depends on the country, not applicable for diisocyanates. The quick connection shall be tightened, the flanges and gaskets surfaces kept parallel, their surface not damaged, the connection shouldn’t be able to move once locked, the connection always circular, without cracks or corrosion. Check presence of all nuts and bolts, and the good conditions of threads. replace once damaged.

hoses supports	c/i	12M	inspection once a year for 10 % of the supports, with rotation every year. In case of damage, 100 % inspection needed	the support shall resist to a weight of 6 times the max weight of the hose once full of liquid. Check the hoses hangers, the support hangers, (for both absence of visible damage) capacity to move in the appropriate direction, the presence of insulation.
hoses valves	check functionality and leakages	3M	replacement after leak	specifications to be defined: at least resistance equivalent to the pipes max pressure, certified for diisocyanates. checks: maneuver for full opening and closing (indication given from the handle 's position) at least once a quarter, absence of leaks (especially at the handle connection), flanges not damaged (flat surface), no cracks / leaks / corrosion at the weld between the flange and the pipe. Check torque of nuts and bolts. presence of identifier replace: in case of leak or crystallization
trace heating	check functionality + settings	3M		see the document "trace heating specifications". Checks: presence of the appropriate voltage, intensity equivalent to the max possible intensity during heating process, the disconnection of the temperature sensors, or disconnection of power shall trigger an alarm .Check position of wires and insulation: Trace wires located under the pipe, electrically insulated (check), max temperature shall be equivalent to 35 °C once heaters in service complete inspection before winter (beginning of November)
insulation integrity	c/i	12M	need to remove the insulation in the most exposed areas (elbows, penetrations, at the bottom of vertical external pipes) and double check after replacement	check: the insulation shall be removed in the most exposed places (check every months to be defined as well as position of inspections) and replaced by approved operators + double check. Absence of water inside the insulation, no trace of corrosion on pipes, or on welds. Check with IR camera to be defined (can it show any deviation?)
piping from flexible hoses to pumps				
filters	replacement periodicity + check	6M		checks: identification of filters positions on a PID, absence of leaks around the filter, replacement of filters (to be defined), presence of nuts and bolts, replacement of gaskets. Presence of identifier
flanges	c/i	each operation		specifications: see additional abstract for ANSI standard checks: surface of flanges (flat) torque settings for nuts and bolts, absence of corrosion or leak on welds, absence of external damage, presence of gasket (and certificate for gaskets), presence of identification for the flange.
gaskets	c/i	each operation	replacement needed	see additional abstract for ANSI standard.the gaskets shall be certified "compatible with diisocyanates", with a thickness and diameter compatible with hose's supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers' specifications if any). presence of identifier. checks: absence of leak or external visible damage
trace heating	check functionality + settings	12 M + 6M	needed in the plants where the risk of loosing utilities gives a probability / severity of > 1e-1 yr and possible stop of production	see the document "trace heating specifications". Checks: presence of the appropriate voltage, intensity equivalent to the max possible intensity during heating process, the disconnection of the temperature sensors, or disconnection of power shall trigger an alarm .Check position of wires and insulation: Trace wires located under the pipe, electrically insulated (check), max temperature shall be equivalent to 35 °C once heaters in service
insulation integrity	c/i	12M	need to remove the insulation in the most exposed areas (elbows, penetrations, at the bottom of vertical external pipes) and double check after replacement	checks: absence of water penetration, correct external protection, absence of physical damage
connections integrity	c/i	12M		see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of leak on instrument connections (pipes on liquid phase) (gauges, sampling valve, purging valve, glass sight, safety relief valves, level indicators). Special attention to be given on gaskets placed after Allweiler pumps or any pump in which a safety relief valve is placed and cannot be tested from the outside).
pipes integrity	c/i	12M	inspection every 20 m on a lenght of 2m for external pipes and 50 m / 1m for internal pipes	checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes.
pipes supports	c/i	12M	inspection of 10 % of the supports inside and 20 % of supports located outside	check presence of support every 3 m, check absence of visible external damage, especially on the wall. Check presence of pipe clamping at each support. Check absence of other loads
vent line (from top of bulk through to tanker connection)				
vent line piping from bulk to vent line hose	c/i	12M	inspection at the connection point to the bulk	check absence of external damage, absence of leak, correct labeling
vent line connection integrity	c/i	12M		see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of leak on connections, level indicators). Special attention to be given on gaskets. Inform if presence of liquids

vent line flexible hose	replacement periodicity + check	12M + check at each operation	regular replacement needed	the hose shall be able to resist to vacuum (> 7 meters water column) without collapsing, and to overpressure (4 bar). The hose shall be certified "compatible with diisocyanates". The hose must be equipped with 4 screws flange connection for diisocyanates and quick connection (diameter different from fair water connection) for polyol. The supplier shall define a replacement date / periodicity. under our experience, replacement every year is a good combination (we've experience of hoses having at least two years without damage, once stored capped an hung). presence of liquid identifier, visible date of replacement and test certificate.
vent line valves	check functionality and leakages	12M + check at each operation		check absence of external damage, absence of leak, correct labeling. Visual: verify complete opening and closing given by the handle position. IMPORTANT: if a sensor on the valve allows a pump to start, check this one.
vent line gaskets	replacement periodicity + check	12M + check at each operation	regular replacement needed	the gaskets shall be certified "compatible with diisocyanates", with a thickness and diameter compatible with hose's supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers' specifications if any). presence of identifier. checks: absence of leak or external visible damage
3-ways valve (to vent line or to dryer)	c/i + functionality	12M		check: once a year, open the valve and remove crystals, if any. Make sure that the valve comes back in the position => to dryer when not in use. Test if the valve opens completely => to tanker when actuated. Test if the valve comes back in the position => to dryer in case of loss of electricity / compressed air. Verify complete opening and closing
dryer	replacement periodicity + check	6M	regular replacement needed	Specs: only silicagel. Remove all carbon filters. Checks: Verify presence of silicagel and its appropriate color (the color is an indicator of wet / dry silicagel) . Check absence of crystals. Replace silicagel once a year. Verify absence of liquid inside silicagel and absence of external damage (corrosion, overpressure, broken glass) and correct torque setting
dryer piping and valves	c/i	6M		checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, Pipes not used as supports for other pipes. absence of flexible hoses
unloading pumps				
internal safety relief valve	usually tests are not possible	12M	no possibility for tests	one option only: dismantling the pump to check the valve . DO NOT close the valve after the pump for this test future specification: installation of an external safety relief valve to replace the internal SRV.
emergency stop	test	2M	specs in SIF definition	see the document "safety instrumented system"
main stop valves	check functionality and leakages	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
main isolation valve (for pumps)	check functionality and leakages	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
glass sight (inside pipe)	c/i	12M		check the absence of leak on the flanges and glass, check torque setting on flanges whenever possible, absence of visible external damage on the glass and gaskets. Check correct coding / identification and position on PID. Verify liquid visibility through the glass.
pumps bypass valves	check functionality and leakages	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
piping from pumps to bulk tanks				
flanges	c/i	12M		see additional abstract of ANSI standard checks: surface of flanges (flat) torque settings for nuts and bolts, absence of corrosion or leak on welds, absence of external damage, presence of gasket (and certificate for gaskets), presence of identification for the flange.
gaskets	c/i	12M	regular replacement needed	the gaskets shall be certified "compatible with diisocyanates", with a thickness and diameter compatible with hose's supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers' specifications if any). presence of identifier. checks: absence of leak or external visible damage
connections integrity	c/i	12M	check each connection	see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of leak on instrument connections (pipes on liquid phase) (gauges, sampling valve, purging valve, glass sight, safety relief valves, level indicators). Special attention to be given on gaskets placed after Allweiler pumps or any pump in which a safety relief valve is placed and cannot be tested from the outside).
pipes integrity	c/i	12M		checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes.

pipes supports	c/i	12M	check one support over 10	check presence of support every 3 m, check absence of visible external damage, especially on the wall. Check presence of pipe clamping at each support.
compressed air for polyol unloading				
compressed air safety relief valve	calibration or replacement	3M		check: presence of pressure regulator set at 4 bar max, presence of safety relief valve opening at 4 bar max, presence and correct functioning of the pressure gauge. Verify presence of indicator "do not use for diisocyanates unloading". presence of certificate for the valve + plumbing + date + pressure. Check presence on PID drawings
pressure regulators	calibration	3M		checks: regulator cannot be set up at a pressure higher than 4 bars. At the max pressure, the SRV shall open.
flexible hoses	replacement periodicity + check	12M + check at each operation	regular replacement needed	checks absence of visible damage, check absence of cracks at connections, verify indication of max allowed pressure.
hoses connections	c/i	12M + check at each operation	check each connection	Check absence of leak and absence of visible external damage on the hose. Check absence of damage on gaskets or replace
bulk storage				
access control	c/i	12M + check at each operation		two options: a card key system or door with code / key . Checks: door closed and correct functioning
dry air blanket on bulk tanks				
compressed air safety relief valve	replacement periodicity + check	12M		check: presence of pressure regulator set at 4 bar max, presence of safety relief valve opening at 4 bar max, presence and correct functioning of the pressure gauge. Verify presence of indicator "do not use for diisocyanates unloading". presence of certificate for the valve + plumbing + date + pressure. Check presence on PID drawings . Test valve and keep records. Plumbing + date + operating pressure
pressure regulators	calibration or replacement	3M		checks: regulator cannot be set up at a pressure higher than 4 bars. At the max pressure, the SRV shall open.
gauges	c/i	12M	calibration checklist	see the BOS procedure for calibration
pipng	c/i	12M		specifications: ASME B31-3 or equivalent. Pipes in stainless steel (preferred solution) 304 60-30x2 EN 10217-7 TP 304 L/I 4307 4301 / 304 WI TCI MS S.A NS 426083 or black iron (S10). Welded connections whenever possible and flanges (assembly and welds as described in ASME B31-4:2006 § 404-3 and 434-8). Allowable stress (min) 150 bar. Min wall thickness 2,6 mm. checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes.
dryers	service / replacement periodicity + check	6M	regular replacement needed	Specs: only silicagel. Remove all carbon filters. Checks: Verify presence of silicagel and its appropriate color (the color is an indicator of wet / dry silicagel) . Check absence of crystals. Replace silicagel once a year. Verify absence of liquid inside silicagel and absence of external damage (corrosion, overpressure, broken glass) and correct torque setting
anti-return valves	replacement periodicity + check	12M	regular replacement needed	1/ the anti return can be tested: internal cleaning with a solvent as described by the supplier (if no indication go to 2). Test, record, and back to operation. 2/ no possibility for test: replace. Specifications: shall operate at 0,1 bar
Bulk tank				
tank foot valve	check functionality and leakages	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
levels indicators (sight tube or visual inspection point)	remove			check the absence of leak on the flanges and glass, check torque setting on flanges whenever possible, absence of visible external damage on the glass and gaskets. Check correct coding / identification and position on PID. Verify liquid visibility through the glass.
bunds	c/i	3M		specifications: equivalent to the highest value between: 100 % of max quantity stored or 50 % of associated tanks in the same bund. Resistant to the action of liquids. Fully tightened. Checks: absence of visible damage, recalculate capacity after modification
tank heating system	remove			not approved without a dedicated SIF (SIL2) able to monitor the overheating. See corresponding specifications
overflowing protection (SIS max level)	c/i and test	12M		checks: see SIS tests checklist. Once every two years, remove (Critical Tasks), and test in contact with Mesamoll. Replace. Triple check after re installation.

safety relief valves	calibration or replacement	12M	calculation of opening to be done	check: presence of pressure regulator set at 4 bar max, presence of safety relief valve opening at 4 bar max, presence and correct functioning of the pressure gauge. Verify presence of indicator “do not use for diisocyanates unloading”. check: calibration or replacement. presence of certificate for the valve + plumbing + date + pressure. Check presence on PID drawings. Check absence of leaks at the outlet. Check absence of obstruction into the outlet line, verify correct connection to the outside
TDI monitor	test and calibration	1M		specification: as close as possible from the most probable emission point (pumps in unloading area, unloading area for road tanker, TDI pumps in the wet-side room, pouring robots booth (after the pouring robot). Max sampling tube : 0,15 m. checks: insert test card on 5 and 20 ppb and read. Check response time of the remote alarm system. Verify test date on paper tape. Verify that yearly maintenance has been done (date and document).
bursting disks	replacement and position	12M	regular replacement needed	specifications: operate at the design pressure of the day tank (max 4 bar). Clear positioning specification shall be visible on the disk (for example with indication: this face outside) checks: absence of broken disk, absence of obstruction (inside and outside, especially if the disk is connected to a pipe) no visible damage, date and pressure settings (verify max pressure settings). airtight connections to the tank. Absence of leaks on the outside.
associated SIF	test	12M		checks: see SIS tests checklist
access to the tank	c/i	12M		specifications: apply EN standard for vertical ladders checks: accessibility, absence of corrosion on ladder support, absence of damage on steps.
pipng from tank to the transfer pump (circulating)				
flanges	c/i	12M		see additional abstract of ANSI standard checks: surface of flanges (flat) torque settings for nuts and bolts, absence of corrosion or leak on welds, absence of external damage, presence of gasket (and certificate for gaskets), presence of identification for the flange.
gaskets	replacement periodicity + check	12 M + each operation	regular replacement needed only in case of leak for the valve at the bottom of the tank	the gaskets shall be certified “compatible with diisocyanates”, with a thickness and diameter compatible with hose’s supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers’ specifications if any). presence of identifier. checks: absence of leak or external visible damage
circulating pump	c/i	12M		specifications: magnetic coupling, external safety relief valve connected without any valve to the pump and recirculating to the pump inlet. Pump design hydraulically calculated. Max pressure settings must be 10 times lower than the max pipes pressure (rupture pressure). Pump specifically approved for the liquids it carries (certificate). Connections with flanges and approved gaskets (see this item). Pump delivered with maintenance scheme and detailed documentation.
pump bypass valves	c/i	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
pump connections and gaskets	c/i	12M	replace the gaskets after each dismantling of the pump	the gaskets shall be certified “compatible with diisocyanates”, with a thickness and diameter compatible with hose’s supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers’ specifications if any). presence of identifier. checks: absence of leak or external visible damage, verify torque settings whenever possible
pump internal safety relief valve			no possibility for tests	specifications: add an external safety relief valve (a valve that can be tested)
pump filters	replacement periodicity + check	12M + check at each operation		checks: absence of external leaks, correct torque settings. Open (permit to work needed), check the absence of crystals and absence of foreign body, clean / replace. Cleaning only as described by the supplier: if no indication, replace.
pipes integrity	c/i	12M		specifications: ASME B31-3 or equivalent. Pipes in stainless steel (preferred solution) 304 60-30x2 EN 10217-7 TP 304 L/I 4307 4301 / 304 WI TCI MS S.A NS 426083 or black iron (S10). Welded connections whenever possible and flanges (assembly and welds as described in ASME B31-4:2006 § 404-3 and 434-8). Allowable stress (min) 150 bar. Min wall thickness 2,6 mm. checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes.
pipes supports	check loads	12M	check one support over 10	check presence of support every 3 m, check absence of visible external damage, especially on the wall. Check presence of pipe clamping at each support.
connections integrity	c/i	12M	check one connection over 10	see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of lead on instrument connections (pipes on liquid phase) (gauges, sampling valve, purging valve, glass sight, safety relief valves, level indicators). Special attention to be given on gaskets placed after Allweiler pumps or any pump in which a safety relief valve is placed and cannot be tested from the outside).
glass sight				check the absence of leak on the flanges and glass, check torque setting on flanges whenever possible, absence of visible external damage on the glass and gaskets. Check correct coding / identification and position on PID. Verify liquid visibility through the glass.
heat tracing and insulation	c/i + settings	12M + 6M		see the document “trace heating specifications”. Checks: presence of the appropriate voltage, intensity equivalent to the max possible intensity during heating process, the disconnection of the temperature sensors, or disconnection of power shall trigger an alarm. Check position of wires and insulation: Trace wires located under the pipe, electrically insulated (check), max temperature shall be equivalent to 35 °C once heaters in service. verify . absence of water penetration and correct external protection. check absence of external damage

piping from transfer pumps to day tanks				
emergency isolation valves	c/i and test	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
emergency stop system (acting on the circulating pump)	c/i and test	12M		checks: see SIS tests checklist
connections integrity	c/i	12M	check one connection over 10	see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of lead on instrument connections (pipes on liquid phase) (gauges, sampling valve, purging valve, glass sight, safety relief valves, level indicators). Special attention to be given on gaskets placed after Allweiler pumps or any pump in which a safety relief valve is placed and cannot be tested from the outside).
heat tracing	settings and C/i	12M + 6M		see the document "trace heating specifications". Checks: presence of the appropriate voltage, intensity equivalent to the max possible intensity during heating process, the disconnection of the temperature sensors, or disconnection of power shall trigger an alarm. Check position of wires and insulation: Trace wires located under the pipe, electrically insulated (check), max temperature shall be equivalent to 35 °C once heaters in service. verify . absence of water penetration and correct external protection. check absence of external damage
temperature monitoring system	test	3M		checks: see SIS tests checklist
temperature SIF	test	3M		checks: see SIS tests checklist
flow monitoring system	test	12M		checks: see SIS tests checklist
flow SIF	test	12M		checks: see SIS tests checklist
insulation	c/i	12M		the insulation shall be removed in the most exposed places (check every xx months to be defined as well as position of inspections) and replaced by approved operators + double check. Absence of water inside the insulation, no trace of corrosion on pipes, or on welds. Check with IR camera to be defined (can it show any deviation?)
penetrations (pipes entering building)	c/i	12M		Specifications: the opening shall be equivalent to the pipe + insulation + external protection total diameter. The external protection shall be sealed (between the external protection and the wall) check the continuity of insulation, the correct protection against water penetration and sealing. Verify correct labeling / color coding on each side of the penetration
supports	c/i	12M	check one support over 10	check presence of support every 3 m, check absence of visible external damage, especially on the wall. Check presence of pipe clamping at each support. Check absence of other loads
earthling	c/i?	12M		depends on the country (see local electrical standard)
pipes integrity	c/i	12M	inspection every 50 m / 1m for internal pipes	checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes.
pipes protection (against forklifts)	c/i	12M		specifications: the protection shall resist to the impact of a forklift @ max speed. If not possible, relocate the piping checks: absence of damage and presence
piping from day tanks to bulk (return line)				
pressure regulator	test	12M		specifications: connection with flanges and gaskets (see the details for each of these points in this document), designed to the max pressure of the piping system, the materials shall not create a galvanic corrosion. The pressure regulator shall be hydraulically calculated, the direction of closing clearly indicated. If possible, the regulator should'nt be fully closed (by design) to avoid an overpressure in the piping. check: absence of external leak, presence on PID, pressure settings made visible.
pressure SIF	test	12M		checks: see SIS tests checklist
pipes integrity	c/i	12M	inspection every 50 m / 1m for internal pipes	specifications: ASME B31-3 or equivalent. Pipes in stainless steel (preferred solution) 304 60-30x2 EN 10217-7 TP 304 L/I 4307 4301 / 304 WI TCI MS S.A NS 426083 or black iron (S10). Welded connections whenever possible and flanges (assembly and welds as described in ASME B31-4:2006 § 404-3 and 434-8). Allowable stress (min) 150 bar. Min wall thickness 2,6 mm. checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes.

pipes protection (against forklifts)	c/i	12M		specifications: the protection shall resist to the impact of a forklift @ max speed. If not possible, relocate the piping checks: absence of damage and presence
connections integrity	c/i	12M	check one connection over 10	see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of lead on instrument connections (pipes on liquid phase) (gauges, sampling valve, purging valve, glass sight, safety relief valves, level indicators). Special attention to be given on gaskets placed after Allweiler pumps or any pump in which a safety relief valve is placed and cannot be tested from the outside).
gaskets	c/i	12M		the gaskets shall be certified "compatible with diisocyanates", with a thickness and diameter compatible with hose's supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers' specifications if any). presence of identifier. checks: absence of leak or external visible damage
piping from road tanker to tank (PURPLAN design)				
wet side Room				
day tanks			design for the lowest dry air pressure inside the tank. Target: to not classify the day tanks as pressurized equipment	
day tanks integrity	c/i	12M		specifications: water jacket not necessary, reduce the operating pressure to the lowest possible value (<< 4 bar). Presence of glass sight level indicator not accepted checks: presence of liquid identifier at each connection updated PID, welds (NDT) inspection (location and number to be defined), absence of external damage, absence of galvanic corrosion, presence and test of safety relief valve.
level indicator (tube)	c/i replace			remove and replace for magnetic indicator in metal tube
overfilling protection	test	12M		checks: see SIS tests checklist
pressure gauge	c/i and test	12M	calibration	specifications: reduce to the lowest amount as possible. Shall resist to the liquids. Indication: between 0 and 10 bar full scale. Location: protected against external aggression. If calibration is needed, one valve locked in opened position before the gauge. Checks: absence of external leaks, correct indication. Calibration as defined in BOS IF NEEDED
safety relief valve	calibration or replacement	12M	regular replacement needed	check: presence of pressure regulator set at 4 bar max, presence of safety relief valve opening at 4 bar max, presence and correct functioning of the pressure gauge. Verify presence of indicator "do not use for diisocyanates unloading". check: calibration or replacement. presence of certificate for the valve + plumbing + date + pressure. Check presence on PID drawings. Check absence of leaks at the outlet. Check absence of obstruction into the outlet line, verify correct connection to the outside
bursting disks	replacement	24M	regular replacement needed	specifications: operate at the design pressure of the day tank (max 4 bar). Clear positioning specification shall be visible on the disk (for example with indication: this face outside) checks: absence of broken disk, absence of obstruction (inside and outside, especially if the disk is connected to a pipe) no visible damage, date and pressure settings (verify max pressure settings). airtight connections to the tank. Absence of leaks on the outside.
manual feeding valve	c/i and test	12M + each operation		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
automatic feeding line (Auto fill valve)	c/i and test	12M + each operation		specifications: refer to the SIF specification check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump, disconnect energy and monitor the time to close the valve. Verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID. Check remote alarms from the positioners. Check the correct position of positioners. Trigger a max level on the SIS "Safety High Level", monitor time for closing / opening and position + remote alarms.
compressed air line (dry air)		12M		Check the max pressure and efficiency of dryer whenever possible. (use a wet bulb temperature indicator: the dry temperature shall be equivalent to wet temperature) or hygrometer (verify calibration) check absence of crystallization inside the dry air line if connected to TDI / MDI or absence of liquids for other chemicals. Check correct coding / identification and position on PID.
anti return on compressed air line	replacement	12M	regular replacement needed	1/ the anti return can be tested: internal cleaning with a solvent as described by the supplier (if no indication go to 2). Test, record, and back to operation. 2/ no possibility for test: replace. Specifications: shall operate at 0,1 bar inform if presence of liquid

pressure regulator on compressed air line	calibration and c/i	12M		checks: regulator cannot be set up at a pressure higher than 4 bars (or any other pressure depending on the design of your specific installation !!). At the max pressure, the SRV shall open. SRV opening and gauge pressure shall correspond
compressed air valves	c/i	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
heat exchanger	(pressure) c/i	12M		specification: the water pressure shall be higher than the TDI MDI pressure (no importance for other fluids) and the water shall be connected to a close loop piping and cooling system (not on potable water directly !). Gauges needed on water side. Safety relief valve on water set at a maximum of 50% of the max allowable pressure of the heat exchanger
water jacketed day tanks	c/i or remove	12M		specifications: disconnect water on TDI /MDI, keep the water connection opened.
return line from pouring head	c/i	12M	inspection for 100 % lenght	specifications: ASME B31-3 or equivalent. Pipes in 304 L stainless steel (preferred solution) or black iron (S10). Welded connections whenever possible and flanges (assembly and welds as described in ASME B31-4:2006 § 404-3 and 434-8). Allowable stress (min) equivalent to 10 times the max pressure of the return line. checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, welds (NDT) inspection (location and number to be defined), presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes.
day tank foot valves	test and check for leakage	12M		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
flanges	c/i	12M	torque settings	see additional abstract of ANSI standard checks: surface of flanges (flat) torque settings for nuts and bolts, absence of corrosion or leak on welds, absence of external damage, presence of gasket (and certificate for gaskets), presence of identification for the flange.
gaskets	c/i	12M	replacement after dismantling	the gaskets shall be certified “compatible with diisocyanates”, with a thickness and diameter compatible with hose’s supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers’ specifications if any). presence of identifier. checks: absence of leak or external visible damage
wet side extraction		12M		specifications (apply only if the room and pipes penetration are totally closed): extraction linked with the opening of the door and a timer, air volume of 5 times the wet side room volume per hour, extraction stopped after 10 minutes, possibility to force on manual mode if needed. Air introduction equivalent to volume extracted. extraction hoods over the TDI /MDI pumps checks: air velocity at the openings (inlets / outlets), timer settings, absence of openings in the room.
wet side access control	c/i	12M		two options: a card key system or door with code / key . Checks: door closed and correct functioning
TDI monitor	test and calibration	12M		specification: as close as possible from the most probable emission point (pumps in unloading area, unloading area for road tanker, TDI pumps in the wet-side room, pouring robots booth (after the pouring robot). Max sampling tube : 0,15 m. checks: insert test card on 5 and 20 ppb and read. Check response time of the remote alarm system. Verify test date on paper tape. Verify that yearly maintenance has been done (date and document).
low pressure pump	c/i	12M		specifications: magnetic coupling, external safety relief valve connected without any valve to the pump and recirculating to the pump inlet. Pump design hydraulically calculated. Max pressure settings must be 10 times lower that the max pipes pressure (rupture pressure). Pump specifically approved for the liquids it carries (certificate). Connections with flanges and approved gaskets (see this item). Pump delivered with maintenance scheme and detailed documentation.
pouring robots				
HP pump and safety relief valves	c/i + test or replace	12M		specifications: magnetic coupling, external safety relief valve connected without any valve to the pump and recirculating to the pump inlet. Pump design hydraulically calculated. Max pressure settings must be 10 times lower that the max pipes pressure (rupture pressure). Pump specifically approved for the liquids it carries (certificate). Connections with flanges and approved gaskets (see this item). Pump delivered with maintenance scheme and detailed documentation.
piping from day tank to high pressure pump	c/i	12M	complete visual inspection	specifications: ASME B31-3 or equivalent. Pipes in stainless steel (preferred solution) 304 or black iron (S10). Welded connections whenever possible and flanges (assembly and welds as described in ASME B31-4:2006 § 404-3 and 434-8). Allowable stress (min) 10 times the max pressure of the pump. checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes. Absence of movement (vibration) on pipes.
flanges	c/i	12M		see additional abstract of ANSI standard checks: surface of flanges (flat) torque settings for nuts and bolts, absence of corrosion or leak on welds, absence of external damage, presence of gasket (and certificate for gaskets), presence of identification for the flange.
gaskets	c /i	12M	replacement after dismantling	the gaskets shall be certified “compatible with diisocyanates”, with a thickness and diameter compatible with hose’s supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers’ specifications if any). presence of identifier. checks: absence of leak or external visible damage

pipng integrity	c/i	12M	content of checks	specifications: ASME B31-3 or equivalent. Pipes in stainless steel (preferred solution) 304 or black iron (S10). Welded connections whenever possible and flanges (assembly and welds as described in ASME B31-4:2006 § 404-3 and 434-8). Allowable stress (min) 10 times the max pressure of the pump. checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes. Absence of movement (vibration) on pipes.
connections integrity	c/i	12M	content of checks	see local standard for piping systems (EN13480 or equivalent to ASME B31). Check absence of leak on welds / threads (check one every xxx), check absence of lead on instrument connections (pipes on liquid phase) (gauges, sampling valve, purging valve, glass sight, safety relief valves, level indicators). Special attention to be given on gaskets placed after Allweiler pumps or any pump in which a safety relief valve is placed and cannot be tested from the outside).
pipng from HP pump to HP flexible hoses	c/i	daily	content of checks	specifications: ASME B31-3 or equivalent. Pipes in stainless steel (preferred solution) 304 or black iron (S10). Welded connections whenever possible and flanges (assembly and welds as described in ASME B31-4:2006 § 404-3 and 434-8). Allowable stress (min) 10 times the max pressure of the pump. checks: presence of liquid identifier and or color at each change of direction / penetration / each accessory, updated PID, presence of supports (to be defined), absence of external damage, absence of galvanic corrosion, presence and test of pressure gauge. Earthing continuity. Pipes not used as supports for other pipes. Absence of movement (vibration) on pipes.
flanges	c/i	12M	torque settings	see additional abstract of ANSI standard checks: surface of flanges (flat) torque settings for nuts and bolts, absence of corrosion or leak on welds, absence of external damage, presence of gasket (and certificate for gaskets), presence of identification for the flange.
gaskets	c/i	12M	specs	the gaskets shall be certified "compatible with diisocyanates", with a thickness and diameter compatible with hose's supplier specifications, replaced as soon as any damage appears on any face (or replaced under suppliers' specifications if any). presence of identifier. checks: absence of leak or external visible damage
flexible hose integrity	c/i	2W	full visual inspection twice a month	the hose shall be able to resist to vacuum (> 7 meters water column) without collapsing, and to overpressure (4 bar). The hose shall be certified "compatible with diisocyanates". The hose must be equipped with 4 screws flange connection for diisocyanates and quick connection (diameter different from faire water connection) for polyol. The supplier shall define a replacement date / periodicity. under our experience, replacement every year is a good combination (we've experience of hoses having at least two years without damage, once stored capped an hung). presence of liquid identifier, visible date of replacement and test certificate. replacement if a damage is detected
flexible hose connections integrity	c/i	1M	visual inspection once per month on each connection	specifications: the hose shall be able to resist to the max pressure of the pump. The hose shall be certified "compatible with diisocyanates" and adapted for wear and tear. The supplier shall define a replacement date / periodicity. Checks: presence of liquid identifier, visible date of replacement and test certificate. Torque settings and visible indicator on assemblies. check absence of leaks
mix head				
recirculation valves	c/i	daily		check the absence of leak (on handle axis / on the flanges), check torque setting on flanges whenever possible, absence of visible external damage. Stop the pump = open and close the valve to verify complete opening and closing, check ability to maneuver. Check correct coding / identification and position on PID.
injectors	c/i	daily		see supplier's documentation for maintenance specifications: the needle is a highly precise instrument, operators must be trained (manipulation, replacement, cleaning)