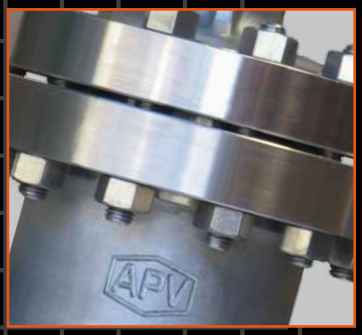
INSTALLATION, OPERATION & MAINTENANCE MANUAL

GATE VALVES

WEDGE & PARALLEL SLIDE

API600/API603/B16.34



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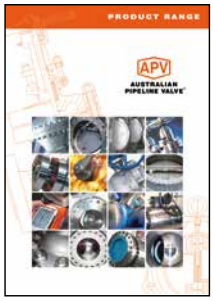

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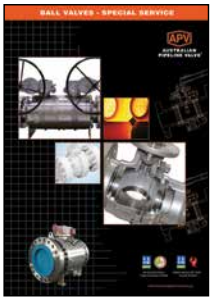

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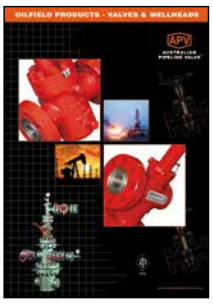

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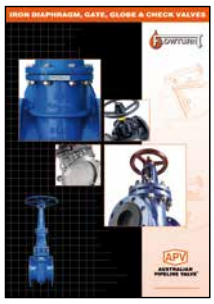

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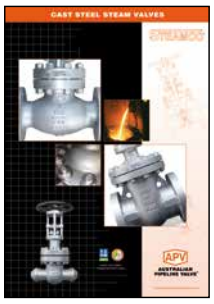

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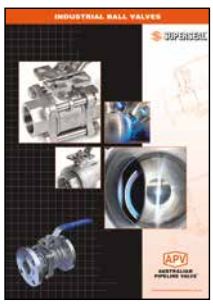

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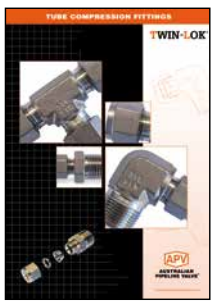

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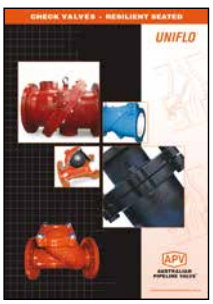

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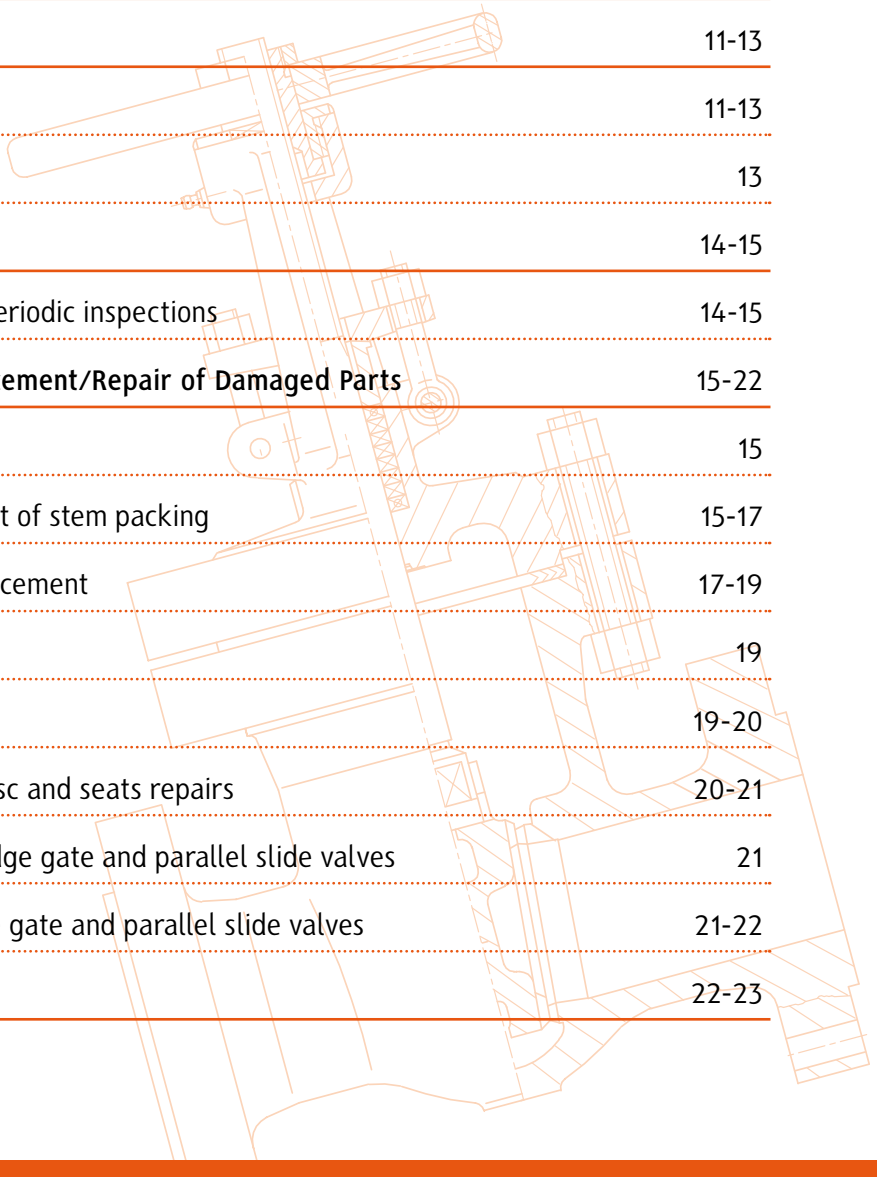

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INTRODUCTION

The majority of this information is common knowledge to experienced valve users. When properly installed in applications for which they were designed, Australian Pipeline Valve (APV) valves will give long reliable service. This instruction is only a guide for installation and operation on standard service and covers general maintenance and minor repairs. A professional APV approved valve engineering facility should be utilised for reconditioning or major repairs.

Note

We recommend that this entire document be read prior to proceeding with any installation or repair. Australian Pipeline Valve and it's parent company take no responsibility for damage or injury to people, property or equipment. It is the sole responsibility of the user to ensure only specially trained valve repair experts perform repairs under the supervision of a qualified supervisor.

RESPONSIBILITY FOR VALVE APPLICATION

The User is responsible for ordering the correct valves. The user is responsible for ensuring APV Valves are selected and installed in conformance with the current pressure rating and design temperature requirements. Prior to installation, the valves and nameplates should be checked for proper identification to ensure the valve is of the proper type, material and is of a suitable pressure class and temperature rating to satisfy the requirements of the service application.

Caution

Do not use any valve in applications where either the pressure or temperature is higher than the allowable working values. Also valves should not be used in service media if not compatible with the valve material of construction, as this will cause chemical attacks, leakage, valve failure.

RECEIVING INSPECTION AND HANDLING

Valves should be inspected upon receipt to ensure:

- Conformance with all purchase order requirements.
- Correct type, pressure class, size, body and trim materials and end connections.
- Any damage caused during shipping and handling to end connections, hand wheel or stem.

Caution

The User is advised that specifying an incorrect valve for the application may result in injuries or property damage. Selecting the correct valve type, rating, material and connections, in conformance with the required performance requirements is important for proper application and is the sole responsibility of the user.

SAFETY INFORMATION

The following general safety information should be taken in account in addition to the specific warnings and cautions specified in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered in this I.O.M.

To avoid injury, never attempt disassembly while there are pressures either upstream or downstream. Even when replacing gaskets or packings, caution is necessary to avoid possible injury. Disassemble with caution in case all pressures are not relieved.

To prevent valve bending, damage, inefficient operation, or early maintenance problems, support piping on each side of the valve. Warning, certain gases and fluids could cause damage to human health, the environment or property hence the necessary safety elements to prevent risk should be taken.

- *A valve is a pressurised mechanism containing fluids under pressure and consequently should be handled with appropriate care.*
- *Valve surface temperature may be dangerously too hot or too cold for skin contact.*
- *Upon disassembly, attention should be paid to the possibility of releasing dangerous and or ignitable accumulated fluids.*
- *Ensure adequate ventilation is available for service.*

At no time shall any weld repair be conducted on the valve while in service. Never strike the valve with a hammer or other impact device. Ensure that no excess weight is placed on the valve that was not part of the original manufacture design.

This manual provides instructions for storing, general servicing, installation and removal of gate valves.

APV and it's resellers refuse any liability for damage to people, property or plant as well as loss of production and loss of income under any circumstances but especially if caused by: Incorrect installation or utilisation of the valve or if the valve installed is not fit for intended purpose. It is the sole responsibility of the user to ensure the valve type and materials are correctly specified.

DURING OPERATION TAKE INTO ACCOUNT THE FOLLOWING WARNINGS:

a- Graphite/Graphoil packing and body gaskets are very brittle, any impacting, twisting or bending should be avoided.

b- The valve's internal parts such as disc, stem, seats, seals, gaskets shall be handled with care avoiding scratches or surface damage.

c- All tools and equipment for handling the internal parts shall be soft coated.

d- Valves can be fitted with gaskets or seals in PTFE, Buna, Viton, etc., hence high temperatures will damage sealing components.

e- Never part open or part close valve. Valve must be full open of full closed to avoid seat damage.

For all operations make reference to position number on part list of the applicable drawing listed.

Caution

Packing leakage could result in personal injury. Valve packing is tightened prior to shipping but may require readjustments to meet specific service conditions.

Caution

Personal injury may result from sudden release of any process pressure. APV recommends the use of protective clothing, gloves and eyewear when performing any installation or maintenance.

Isolate the valve from the system and relieve pressure prior to performing maintenance.

Disconnect any operating line providing air pressure, control signals or electrical power to actuators.

Caution

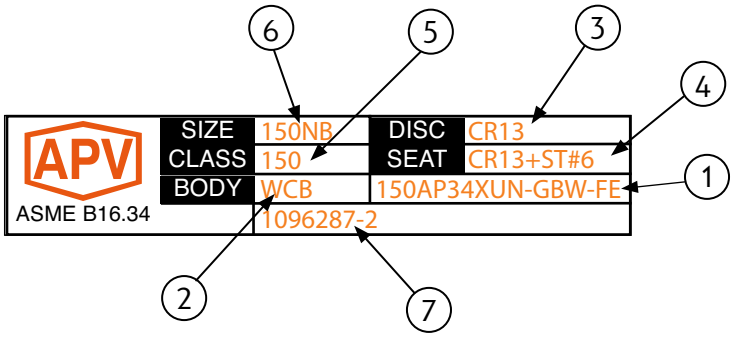
Check the packing box for pressurised process fluids even after the valve has been removed from the pipeline, particularly when removing packing hardware or packing rings, or removing packing box pipe plug.

Caution

If a gasket seal is disturbed while removing or adjusting gasketed parts, APV recommends installing a new gasket while reassembling. A proper seal is required to ensure optimum operation.

VALVE IDENTIFICATION

Each APV valve is identified with a nameplate. Below is an example.



ITEM	DESCRIPTION
1	APV valve figure number which delineats the as-built valve type, body, trim, features, packing, NACE, etc. Refer Figure Number System Appendix C
2	Shell material (e.g. body, bonnet)
3	Closure member material
4	Seat material
5	Rated pressure class as per ASME B16.34. Section 2
6	Nominal pipe size
7	Serial/batch number

When performing any work, ordering spare parts, or requesting technical support, please refer to this tag. The serial number, the part number and numbers cast on the side of the valve body are keys to proper valve identification.

1.0 INSTALLATION

Caution

Piping should be properly aligned and supported to reduce mechanical loading on the end connections.

1.1 INSTALLATION POSITION

Gate valves are usually bi-directional, and therefore may be installed in either direction. There may be exceptions to this if bypass piping is welded to the valve body or if a pressure relief hole is drilled in one side of the valve gate. Check your piping layout drawing to ensure correct position and direction of flow. If in some cases, gate valves are uni-directional, the direction of flow will be indicated on the valve body. Gate valves should be installed with the stem in a vertical upright position on horizontal lines. If installed with the stem below the horizontal axis, complete drainage is not possible and solids may accumulate in the valve bonnet, which will greatly affect the valve operation and service life. Gate valves may also be installed in vertical lines you must specify this at order stage.

Cast steel gate valves will operate perfectly in an upright position when the wedge/disc gravity feeds into it's seating position. However, when the valve is on an angle, sloppiness combined with slight burrs and machining imperfections can cause the valve not to track properly in it's position every time it is closed. Manufacturers will claim all their valves will close perfectly in any position however, in practice this is often not always the case. If the valve is not being used in a conventional horizontal pipeline, this should be specified at the time of order as it's best that unless the size/class being used has been proven as reliable, the valve should be function tested to prove it correctly seals in the desired angle in which it will be installed. The valve may be installed in other orientations, but any deviation from vertical is a compromise. Installation upside down is not recommended because of possible dirt build-up in the bonnet. It is best to consult APV during quotation review process as to remedial measures required (hardfacing of guides) when valves over 300mm (12") are tilted beyond 45° from the stem vertical orientation.

1.2 PREPARATION FOR INSTALLATION

- Valves should be in full closed postition to protect seat, and in the case of weld end valves avoid any potential distortion of seat. If the valve is left open or partially open, it could distort and leak during operation. Also, leaving the valve in a fully closed position helps prevent weld spatter from falling directly onto the mating faces of the seats.
- Remove protective end caps or plugs and inspect valve ends for damage to threads, socket weld bores or flange faces.
- Thoroughly clean adjacent piping system to remove any foreign material that could cause damage to seating surfaces during valve operation.
- Verify that the space available for installation is adequate to allow the valve to be installed and to be operated.

Ensure sufficient clearance for the stem in the full open position. Inadequate clearance for valves may add mechanical loading to the valve ends. Sufficient clearance should be allowed for threaded end valves to be 'swung' during installation.

1.3 END CONNECTIONS

1.3.1 Flanged Ends

Check to see that mating flanges are dimensionally compatible with the flanges on the valve body ensure sealing surfaces are free of debris. When installing flanged or ring joint end valves into the line, it is advisable to have the valve slightly open to prevent the wedge from becoming "stuck" due to thermal expansion and to discourage damage to the seating surfaces.

Install the correct studs and nuts for the application and place the gasket between the flange facings.

Stud nuts should be tightened in an opposing criss-cross pattern in equal increments to ensure even gasket compression. Refer Appendix A, FIGURE 5.

1.3.2 Buttweld End Valves

Clean the weld ends as necessary and weld into the line using an approved weld procedure. Make sure the pipe and valve body material given on the nameplate or valve body is compatible with the welding procedure. (Refer the compatibility cross reference chart at our website for equivalent pipe, valve & fittings grades).

1.3.3 Valve Installation by Welding

Leave valves assembled and in the lightly closed position during installation, welding and post-weld heat treatment. This will prevent the valve seat from floating or distorting during the process. After welding completion, open the valve and flush line to clean out any foreign matter.

Remove the bonnet and bonnet gasket and match mark each component during dis-assembly for proper reassembly.

A protective paint may have been applied to the weld ends on some valves, and it should be removed before welding, unless it is a deoxaluminate paint which acts as a welding flux and does not need to be removed.

Use the smallest electrodes and the minimum amperage possible consistent with approved welding procedures. This will help to minimise warpage in the seat areas. Tack weld should be ground out before completing the root pass in that area.

Valves of carbon steel should be allowed to cool slowly. The valve may be covered with a heat-insulating

blanket to promote slow cooling and limit the heat-affected zone. Appropriate industry standards should be followed for all PWHT.

The responsibility for welding of the valves into piping systems is that of those performing the welding. Refer to ASME B31.1, B31.3 etc. Written welding procedures covering all attributes of the process and materials to be welded shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code and any additional requirements from the applicable piping code including any possible necessary localised post weld heat treatment depending on material specifications.

1.4 POST-INSTALLATION PROCEDURES

After installation, the line should be cleaned by flushing to remove any foreign material. When caustics are to be used to flush the line, additional flushing with clean water is required. The valve should be opened and closed after installation to ensure proper operating function.

With the line pressurised, check the valve end connections, body to bonnet/cover joints and stem packing area for leaks. The packing may have to be tightened to stop packing leakage.

2.0 OPERATION

Gate valves should only be used in the fully open or fully closed position. Gate valves are not designed for throttling to control the flow, they are normally fully open or fully closed. If left in patrially open position, could result in severe damage to body seats, wedge, stem & guide rails

Gate valves should not be left in the fully 'backseated' position under normal operating conditions. The packing may dry out under these conditions and leak as the valve is closed. Once the valve is brought into fully open position (back-seated), turn the hand wheel back one full turn. However, depending on size, class and media, some operator still choose to leave the valve backseated when open. Some minor leakage will still occur past the backseat.
Under no circumstances should the backseat be used to allow gland packing replacement or repair while the valve and system are pressurised.

A cool valve may leak through the gland when opened to hot fluid. Wait before tightening the packing as the problem may go away.

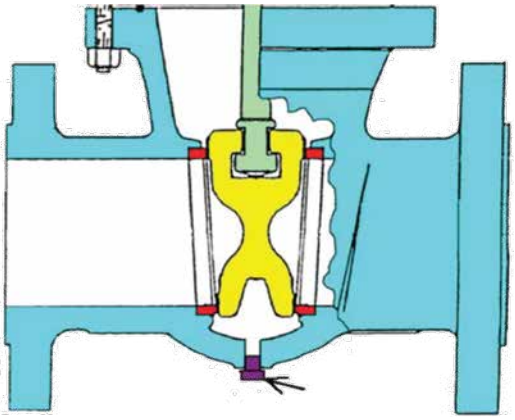
1. To open the valve, turn the handwheel in counter clockwise direction, continue turning until interference is felt and at this point the valve will be fully open. To close the valve, turn the handwheel in a clockwise direction, continue turning until interference is felt and at this point, the valve will be fully closed.
   With some larger high pressure valves, a rim pull of more than 350NM may be required to achieve proper seating.
2. When a valve is in the full open position, rotate the handwheel one quarter turn back from the fully

open position. This action will ensure that packing tightness is verifiable.

3. Backseating a valve is means of stopping or reducing packing leakage until the packing can be replaced. Valve packing should only be replaced when the valve is NOT under pressure. It is not recommended to repack a valve under pressure. To backseat the valve, rotate the handwheel to the fully open position; do not over torque as this will cause thermal binding.
4. The performance of the valve will be better if the flow is smooth. It is suggested to avoid installation of valves where turbulence is expected (e.g. immediately after elbows, bends, pumps, etc).
5. Valves that are not operated frequently; remaining in the open or closed positions for long periods of time should be partially operated on a monthly basis to expel lubricant throughout the stem nut, bearings or gears. Excessive effort to open or close the valve may indicate the valve stem needs to be lubricated, or the valve packing compression is too tight, or if debris and particle matter on the threads are preventing the operation of the stem. Damaged components should be considered when the valve will not operate after all efforts or adjustments and lubrication has been completed.

When the valve stops in closed position and is leaking do not try and force or cheat, instead try to back off the valve just a little and let the line pressure seal the valve. Forcing the valve further down will result in damage. The valve will seal on the downstream seat.

However, on the flexible wedge gate valve you can potentially for very low pressures and sizes obtain a double isolation when closing the valve. The valve is to be closed with force, but no more than required to flex the gate to be in perfect contact with 100 per cent of the seats seal area.



To prove a double barrier you need an auxiliary valve & gauge in the cavity. Of course there will be a leakage rate as per API 598, but since it is only one seat do not necessarily expect this leakage rate. It it not sufficient to use bleed plug as this may be blocked and create a dangerous situation.

These valves are designed to operate within the pressure and temperature limits of ASME B16.34. Do not exceed these limits.

3.0 MAINTENANCE

Proper safety equipment and apparel should be worn when preparing to service a valve. Observe the following general warnings:

Tools Required: - aside from standard wrenches (for bonnet cap screws and packing gland nuts) the only special tool needed for minor Australian Pipeline Valve valve maintenance is a packing hook.

3.1 GLAND PACKING

Special care is to be placed in the tightening of the gland nuts during installation, to ensure the proper packing adjustment and functionality.

The packing gland should be checked periodically in service and tightened as necessary to stop leakage around the stem. Tighten in a manner to develop even loading on the gland. Tighten only enough to stop the leak.

3.1.1 Removal of Packing Rings and use of Backseat

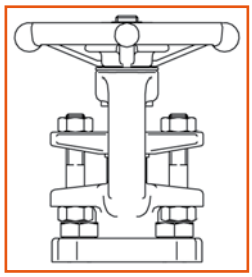
The backseat is not designed to be used to allow gland packing replacement or repair while the valve is pressurised. The primary reason for the backseating facility is to temporarily reduce leakage until the valve can be removed from the line to replace packing. One of the most common errors is to believe that if the Gate valve is back-seated (fully open position - and backseat sealing is made), this will help to prevent wear of the packing rings. Unfortunately using the backseat in this way over a longer period of time in some situations, could result in some serious issues:

a) Since the body, bonnet, stem and disc heat up and expand at different rates, experience shows that valve can get jammed/blocked in back-seated position.
b) The gland packing will dry out since it's not exposed to the stem, and could immediately blow upon closing of the valve.

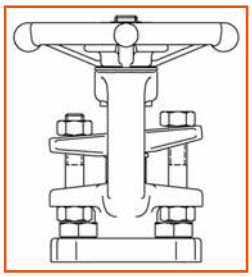
When placing a new valve into service, Australian Pipeline Valve recommends a preliminary packing adjustment to verify proper packing load. Additionally, it is recommended that a Baseline Leakage Test be performed following installation, but prior to start-up.

During the packing life cycle, normal and routine maintenance of the packing arrangement must be administered. Normal cycle life will typically require 5 to 8 packing gland nut adjustments. Torque values vary depending upon valve size. Refer to the Packing Bolt Torque chart in Appendix A table B for the recommended torque values. Tighten the packing nuts clockwise to compress the packing. Do not over tighten or the valve will become too tight to turn (see 5.2.1). Fugitive emission stem packing can be fitted to reduce leakage rate to as low as 100 PPM (stem & stuffing box smoothness must be in accordance with packing manufacturers specifications) for 1,500 cycles (APV valves are fugitive emission prototype tested). Removal of old packing should be done in an experienced workshop, using a special flexible removal tool. The removal tools have special hooks, which screw into the packing ring. Removal of the packing ring is a difficult and time-consuming operation. Care has to be taken not to scratch the stem of the walls of the packing chamber during the removal of the packing rings.

FIGURE 1



RIGHT



WRONG

Caution

Over tightening will cause the packing to fail prematurely as well as increasing the force required to operate the valve. The packing gland flange should not bend even slightly, if it does you have over-tightened and have to replace the flange.

If the leak cannot be stopped by tightening the gland nuts, it is necessary to add additional packing rings or completely repack the valve. Adding additional packing rings may damage the stem sealing system over a longer term. While Australian Pipeline Valve gate valves are equipped with a backseat feature, it is NOT ALLOWED TO REPACK THEM UNDER PRESSURE.

For normal operation in the open position, the stem should be backed off so that the backseat is not in contact. This permits the stem packing to assume it's intended sealing function and not conceal unsatisfactory stem packing. In the event of stem packing leakage, the backseat can be used to stop stem leakage until circumstances permit a system shutdown and time for packing replacement. Stem packing replacement with the valve under pressure and backseated represents a hazard and should not be undertaken. The hazard is magnified as fluid pressure or temperature increases or when the fluid is toxic.

Caution

Backseating the valve and attempting to repack under pressure is hazardous and is not allowed under any circumstances. Rather than attempting to repack under pressure, it is preferable to use the backseat to control the stem leakage until shutdown of the line provides safe repacking conditions.

Prior to replacing the packing rings, remove all pressure from the valve. If the backseat faces have been damaged by foreign material the backseat may leak into the packing chamber.

Australian Pipeline Valve PTFE and Graphite packing and sets are usually die formed/moulded and have no end cut. As a result, these rings cannot be replaced without removing the valve bonnet. If the valve is to be repacked without removing the bonnet, care must be taken when removing the original packing not to scratch the valve stem sealing surface. For fugitive emission service, proprietary fugitive emission packing must be used.

Note, PTFE has superior sealing properties compared to graphite, but is not firesafe.

A compatible ribbon packing system or equivalent braided packing stock should be used but the emission will be higher. Also, torque may increase. A stuffing box corrosion inhibitor is recommended. The joints in the packing rings should be diagonally cut. When installing the rings, care should be taken to stagger the ring joints. Where it is necessary to repack the valve in-line, ensure the line pressure is totally isolated and no fluid remains, prior to attempting to repack valve in-line (refer 5.2). Wear anti-splash eye protection goggles.

Especially in the case of dangerous, hazardous, volatile, caustic or flammable liquids or gases, do not ever attempt to repack the valve in-line even if pressure has been isolated.

Other specialty packing such as V-ring Teflon will require that the valve be disassembled if repacking is required.

3.2 REPAIRS

Due to the relatively low replacement cost of small diameter standard carbon steel valves under 100NB, it is usually less expensive to replace the complete valve than to have maintenance personnel carry out repairs. Additionally, in the case of gate valves, it must be removed from the line in order to replace or reface seat rings. Generally, the only justifiable repairs are replacement of packing and gaskets as previously described. However, see Section 4.0 and 5.0 for further maintenance.

Always replace the bonnet gasket whenever a valve is disassembled. After removing valve from line, use adequate force to remove bonnet. Gasket seating surfaces should be scraped clean (avoid radial marks). Bonnet bolts should be tightened in a diagonal pattern at several different increasing torque settings until the final recommended torque value is attained. (See table A in Appendix A, including FIGURE 5.) 'Pressure seal' bonnets (see drawing example only Appendix B) require a proprietary gasket, do not attempt to use non genuine gaskets.

During maintenance or servicing of the valve, all replacement parts must be the same as the original specification (parts dimensions and materials). End user may also purchase the spare parts such as packing, gaskets, bolt/nuts, etc. when ordering the valve. With the new packing, gasket or bolt/nuts installed, the valve must be applicable pressure testing prior to installation and service.

4.0 MAINTENANCE PROCEDURES

4.1 PREVENTATIVE MAINTENANCE AND PERIODIC INSPECTION

APV recommends that periodic inspections be carried out on all valves. The frequency of these inspections depends on the severity of the service and the frequency of the valve operation. As a minimum, all valves should be inspected quarterly to ensure proper operation and discourage the damage compounding effects of leakage. The following list details areas requiring inspection and maintenance.

Items to Inspect
Check all lubrication points
Check body/bonnet join for leaks
Check for packing leaks
Check stem threads for wear
Ensure stem and seal areas are free from debris
If conditions permit, operate valve
Inspect all external connections
Inspect condition of actuator and/or gear operators (if applicable)
Inspect valve for obvious damage

Caution

Do not remove or loosen the packing gland or bonnet bolts while the valve is pressurised.

1. The valve stem packing should be inspected monthly. If the stem packing shows signs of leakage, simply tighten the adjusting nuts to compress the packing. Do not over tighten the adjusting nuts as this will make operation of the valve more difficult. If, after tightening the adjustment nuts to their fullest extent, the leakage does not stop, it is then necessary to replace the stem packing. It is not recommended that additional packing rings be added to the stuffing box as this may cause damage to the stem sealing system. For packing replacement see Section 3.2 and 5.2.
2. Regular maintenance of the valve is required to assure smooth operation. Stem threads should be inspected and lubricated frequently to ensure ease of operation. APV valves are supplied with the stem threads engaging the yoke nut pre-greased. These components should be kept constantly lubricated by applying the grease directly on the stem when the valve is in the open position or through the grease injector in the yoke nut when provided. Lubrication/greasing of the stem should be conducted every six months or more often as needed, based on the environment the valve is installed. Inspection should confirm that the valve is sealing properly. Stem packing should be inspected at least every six months to ensure zero leakage from the packing chamber. For water & oil service, regular maintenance should

be scheduled every 3 months. For more corrosive mediums, inspection and maintenance should be completed once a month.

3. Bonnet bolt tension should be checked periodically when valves are used in high temperature applications where creep may occur. Although leaks through bonnet ring or spiral gaskets are rare, erosion or corrosion could cause bonnet seal to fail. In these cases, a new gasket is required. Refer 3.1 for replacing bonnet gasket. Refer Appendix A, Table A and Figure 5 for torque figures and tightening sequence.
4. With problematic service applications it is recommended that the valve be periodically at least partially stroked to ensure valve functions and to ensure there is no product deposits entering into seat or stem area which may render operating more difficult. Duration depends on service, criticality, etc. However, it also must be factored in that if there are impurities or particulates in the line which are likely to be built up in the seat area, each operation could reduce seat life proportionately.

5.0 EXTRAORDINARY MAINTENANCE

5.1 STEM

If the stem locks or "freezes", causes can generally be attributed to dry worn packing or a dry yoke nut. In either of these cases, the following service is required:

a) Unscrew gland nuts, remove the gland flange and bushing to expose stem packing and lantern ring/ packing spacer (where applicable). Replace stem packing if it is damaged. If the lantern ring is seized, completely disassemble the stem and replace the lantern ring (where one is fitted). Smaller sizes and larger sizes with fugitive emission packing sets do not require spacers/lantern rings as standard.

b) Check lubrication of yoke nut. If it is dry, remove the yoke nut and determine if there is evidence of seizure marks. If so replace it with a new yoke nut.

5.2 GLAND DISASSEMBLY & REPLACEMENT OF STEM PACKING

In those cases where the valve cannot be removed from the piping system, it is important that prior to servicing, the valve be opened to its fullest extent and the valve be purged of any pressure and fluid (protective goggles should be worn). Partially unscrew nuts to reduce the compression load on the stuffing box. Next, if so equipped, remove the stem plug to check that there is no leakage. Remove the stem packing and, if so equipped, the lantern ring and bottom set of stem packing.

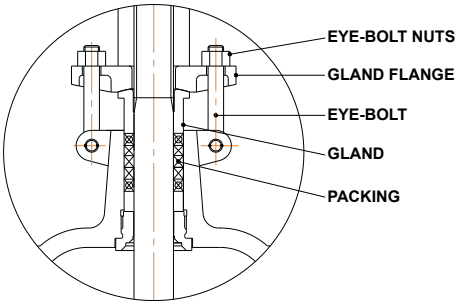
5.2.1 Stem Packing Replacement

First remove the valve from the line. To prevent injury ensure that all fluid and pressure is removed from the valve both upstream and downstream before removal and disassembly. When removing drain or stem plug wear protective eye masks to avoid injury.

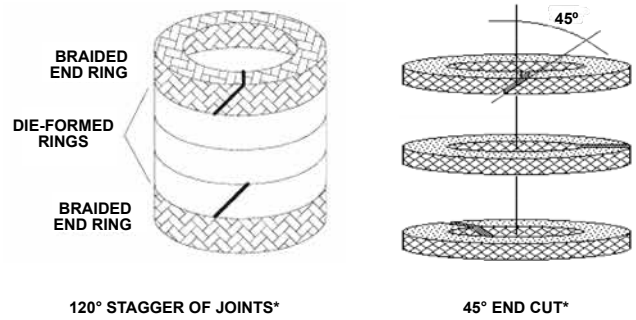
1. Check tightness of valve operation to serve as a reference when re-tightening. Remove gland nuts and the hook. Lift the gland up the stem clear away from the packing chamber.
2. Remove the defective packing rings with a sharp tool or packing hook. Do not scratch or score the machined surfaces of the stem or packing chamber.
3. Examine the machined surfaces of the stem and packing chamber. Remove any scratches, scoring or burrs with an emery cloth or by hand filing. Clean the stem with a solvent soaked rag.
   Scratches to the stem and the packing chamber no deeper than 0.25mm (0.010") can be removed by polishing the surface with a buffing wheel. The surface finish of the packing chamber should be Ra 3.2µm and the stem should be Ra 0.5 ~ 0.8µm.
4. Count original number of rings and measure x-section thickness. If original packing cannot be counted or measured, follow the steps below:

   a) Measure the stem diameter (OD), stuffing box diameter (ID) and stuffing box depth (d).
   b) Packing x-section (R)=(ID - OD)/2
   c) # rings = (1.25 x d)/R
5. Install new packing. Use a genuine APV low emission, low friction packing set. If using standard coils of packing material: cut each ring at a 45 degree angle and stagger the joints at 120 degrees, every fourth joint will be in the same position as the first. Install rings individually using a split ring spacer, compressing each ring by hand tightening + 1/4 turns on each packing gland nut.
6. When packing chamber becomes filled with packing, reassemble gland and gland flange. Alternate tightening packing gland flange nuts 1/4 turn at a time until eyebolts begin to get tight. (If gland travels more than the height of one packing ring into the packing chamber, insert one more ring and repeat step 6. until chamber is filled).
7. Compare valve operation to original tightness. If valve operation is considerably tighter than original operating tightness, back off 1/4 turn on each gland nut & recheck tightness. Where proprietary packing sets are used such as (example only) Garlock EVSP 9000, Burgmann 6070 or Chesterton 1622 please consult packing manufacturer's torques. The serialised as-built drawing will indicate the packing used, please refer to APV. Various packing types, materials, proprietary combinations and styles with and without spacers/lantern rings, etc, and torque limitations of some bolting materials, bonnet design variations, stuffing box and stem smoothness, means it is not possible to safely publish recommended torques for packing. In addition, higher pressure ratings will require higher torques especially if media types are hazardous or more leak searching prone such as gas.
8. Several hours after a repacked valve has been returned to service, inspect the packing area to ensure full compression, tight bolting and no leakage. Should leakage occur, tighten gland nuts at 1/4 turn increments until leakage stops. Do not over tighten or valve will become difficult to turn.

FIGURE 2



Stuffing Box*



Stem Packing*

* Example only, refer to as-built drawing. Genuine APV die formed packing sets recommended for fugitive emission service. Set shown is example only, refer to as-built drawing.

Note

The stem packing style will vary according to valve size, type and class as well as the stem packing material specified. Examples include combination sets, wire reinforced braided packing, PTFE Chevron moulded sets, live loaded sets.

5.3 BONNET DISASSEMBLY & STEM REPLACEMENT

Before disassembly:

1. Check that the line is in a complete shut down phase then remove the valve from the line.
2. Pre-order all necessary spare gland packings and jointing gaskets.
3. Open the valve slightly by turning the handwheel anti-clockwise and loosen the gland.
4. Put identification markings on valve body, bonnet, disc/wedge, yoke and actuator. This helps to avoid mismatching of parts at the time of re-assembly.
5. If the bolts and nuts are too tight, apply deep penetrating oil then unscrew.

Refer to Sections 5.3.1 & 5.3.2 for removing the bonnet.

To replace the stem when the valve is completely disassembled for general maintenance follow this procedure:

- Open valve half way then remove bonnet bolts and nuts.
- Lift up the bonnet to remove wedge. The wedge has to be reassembled in the same position as originally assembled: take care not to rotate it 180°. The valve could leak through the seats if wedge is rotated.
- With the bonnet removed, unscrew the gland bolts then lift up gland flange exposing the stem packing.
- Remove stem packing above the lantern ring (if so required) and then turn the hand wheel to force the stem down.
- Remove the stem through the stuffing box. Turn the bonnet up side down and remove lantern ring.
- If so equipped, remove stem packing below the lantern ring.

Caution

Always be sure that the valve is de-pressurised and isolated prior to performing any maintenance work. Do not attempt to repair valve in-line if volatile, dangerous, hazardous or flammable service.

Note

Welded bonnet valves can be replaced but otherwise are not repairable.

5.3.1 Bolted Bonnet Removal & Gasket Replacement

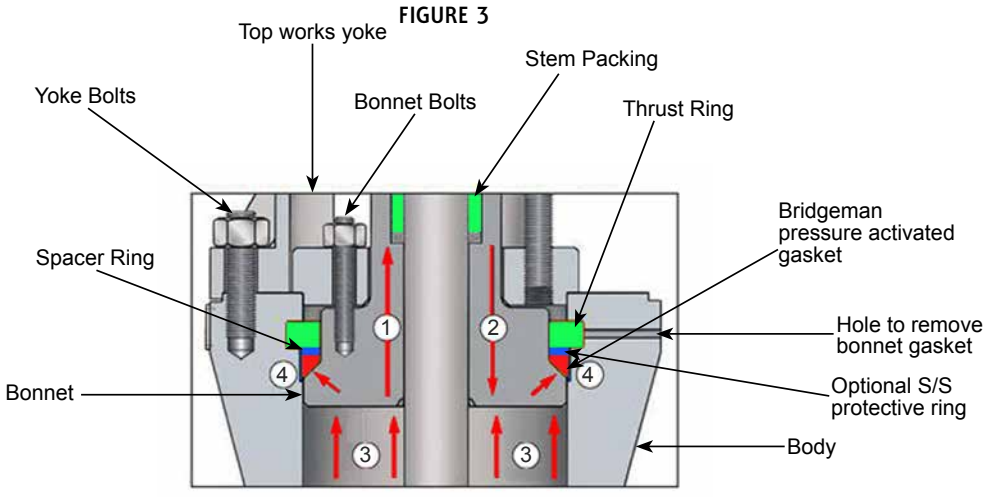
Always replace the bonnet gasket whenever a valve is disassembled. Gasket sealing surface should be scraped clean (avoid radial marks).

1. Disassemble all cover bolts and nuts.
2. Lift up the bonnet using lifting lugs where provided, evenly break the bonnet seal with a lever if required before lifting the bonnet off (where required with a sling and mechanical lifting device).
3. Clean gasket surface areas, replace gasket and refit bonnet as detailed below.

5.3.2 Pressure Seal Bonnet Removal & Gasket Replacement

In 900 to 2500 class a 'pressure seal' bonnet (see drawing example only Appendix B) may be specified. The bonnet bolts effect a seal on the pressure seal joint which forces the bonnet onto the gasket which in turn is forced up hard against the outer body, refer example FIGURE 3 below. The higher the line pressure, the higher the sealing force against the gasket, further tightening the seal. The thrust rings are embedded in the body. Live loading bonnet bolt washers are available which can be tightened to ensure a constant force is applied to the bonnet gasket.

FIGURE 3



①② Bonnet can move up or down as pressure increases and decreases
③ Line pressure
④ Line pressure further tightens Bridgeman gasket seal

The above drawing is indicative only, there are different pressure seal bonnet styles (refer APV as-built drawing).

Only an experienced APV approved valve repair professional should attempt disassembly of pressure seal bonnet valves.

There are different designs of pressure bonnet: - locknut type (breech lock), bonnet take-up type (bolted yoke arm) and the bolted style shown in FIGURE 3, hence, refer to as-built drawing.

The procedure to remove a pressure seal bonnet is as follows. This is an example only:

1. After disassembling the gland (refer 5.2) remove the bonnet bolts (or the threaded breech-lock bonnet).
2. Insert a knock-out pin (where applicable) into drilled hole so the segmented thrust ring can be driven out from the retaining groove.
3. The optional S/S protective ring and the gasket can then be removed.
4. Clean the gasket area and always fit a new gasket before reassembly.

5.4 VALVE REASSEMBLY

The procedure to reassemble the valve is as follows:

Re-insert the stem through the stuffing box taking special care to reassemble parts in sequence. If so equipped, avoid allowing the lantern ring to slide into the stuffing box. If the valve is equipped with a lantern ring, first insert packing rings into the stuffing box followed by a lantern ring (where applicable). Next, insert the remaining packing rings into the stuffing box and compress using the gland and flange. Then, reassemble nuts and tighten.

Note, the stem must slide freely through the stuffing box without applying excessive force. Finally, install the bonnet gasket making sure it is not damaged. The gasket should be replaced if there is any question as to its performance (refer 3.1).

Raise the bonnet, making sure the stem is in the half open position, then connect disc to stem. Lower bonnet on to the valve body making sure that the disc fits exactly into body guides and the bonnet is properly seated. Align holes and tighten bonnet nuts taking care that excessive force is not used, to avoid damaging the gasket. Hydrostatically test the valve to ensure that there is no leakage.

5.5 DISASSEMBLY OF YOKE NUT

When necessary use the following procedure for disassembling and replacing yoke nut:

a) Direct hand operated valves (hand wheel)

- Remove set screw;

- Unscrew hand wheel nut;
- Remove hand wheel;
- Unscrew yoke but retaining nut, removing spot welds if necessary.

Reverse the procedure for reassembly.

b) Bevel gear operated valves

- To remove the bevel gear from the valve, unscrew nuts and turn the hand wheel in the open direction indicated by the arrow until the drive nuts are disengaged from the stem.
- To check the condition of the drive nut or bearing, unscrew the retainer ring and remove drive nut and bearing. If damaged, a new drive nut or bearing is necessary.

5.6 DISASSEMBLY OF VALVE - WEDGE/DISC AND SEATS REPAIR

An indication of valve leakage is a pressure loss in the high pressure line side after a valve has been properly closed. In the case of hot water or steam lines, note whether the downstream pipe remains hot beyond the usual length of time. This type of leak may be the result of a distorted seat caused by improper welding of the valve into the pipeline or seating damage caused by foreign particle matter or by stress relieving temperatures that may have been used during installation.

Leaks can also develop from failure to close the valve tightly, resulting in high-velocity flow through a small opening. Trim materials like CR13 (410SS) and especially hardfacing materials like Stellite 6 are corrosion and erosion-resistant, but grooves, pit marks or other surface irregularities may still form on the mating surfaces. Valves which leak should be repaired as quickly as possible to prevent greater damage caused by high velocity.

Leakage through seats and wedges/discs cannot be verified when valve is in service (unless a downstream drain is fitted). However, when leaks are identified, immediate action is necessary. Any delay can permanently damage the seat or wedge/disc seal surfaces. Never leave valve part open when in service as gate valves are not designed to throttle flow. Leaving valve part open will result in damage to wedge/disc and seats due to venturi action erosion.

To repair or replace disc or seats, the valve must be removed from the line then first follow the same procedure in 5.3 and then:

- Make sure that the valve is not under pressure before unscrewing bonnet nuts.
- Remove bonnet, being careful not to damage the gasket.
- Remove bonnet when wedge/disc is in half open position.
- Lift up bonnet until wedge/disc is disconnected from guides.
- Release wedge/discs from stem.

If seat surfaces show signs of seizing, pitting, grooves or other defects not deeper than 0.8mm (1/32”) (see 5.7, 5.8) it is possible to repair seating surfaces to its original condition by relapping the surface with line grain abrasive paste, creating perfect tightness once again. Refer to 5.7, 5.8.

Defects having a depth exceeding 0.8mm (1/32”) (see 5.7, 5.8) cannot be repaired by lapping, in this case, parts must be replaced or professionally reconditioned by an APV approved reconditioner.

It is recommended that the face of the disc be blue metal tested to check for contact of seating surface after final lapping. For re-assembly of valves use the procedure outlined under paragraph 5.4.

If valve is custom fitted with special soft seat inserts – consult APV.

Note, if the valve was ordered to a higher level of shut-off class, then the seating surfaces will have to be blue metal matched until the required shut-off is attained.

5.7 WEDGE AND DISC RE-LAPPING – WEDGE GATE AND PARALLEL SLIDE VALVES

a) After disassembling valve as described in 5.3 to 5.6, inspect the wedge or disc for scratches or damage.
b) If seating faces are scratched, the wedge or disc must be lapped. Slight pitting, grooving or indentions no deeper than 0.1mm (0.005") can be removed by lapping. If defects cannot be corrected by lapping, wedge or disc should be ground or machined by an APV approved valve reconditioning professional.

For Wedge Gate, APV recommends that a maximum of 0.4mm (0.015") on each side be removed from a 10° seated wedge and 0.25mm (0.010") on each side for a 7° seated wedge.

For Parallel Slide Disc Gate APV recommends maximum removal of 0.89mm (0.035") per disc. New springs should also be fitted for parallel slide valves as old springs loose their ability to assist an effective seal.

Note, if more than 0.89mm (0.035") total must be removed from both discs and seats of a parallel slide valve (see drawing example only Appendix B), *then the retainer plate and or disc groove must also be ground, milled or machined to compensate for gap allowance.*

c) For the lapping, a flat plate, preferably cast iron, should be used and an abrasive lapping compound mixed with olive oil should be evenly distributed over the plate. Only light, even pressure should be applied to the plate, lifting the wedge or disc as often as possible to prevent accumulation of particles in one area and to follow for proper distribution of the lapping compound. The lapping plate should be turned slightly every few strokes to maintain a flat surface. The part should be lapped until seat faces are smooth. APV recommends the use of silicone carbide compound, medium coarse and fine grit compound for finishing.
d) Thoroughly clean off the lapping compound with a suitable cleaning fluid such as acetone or alcohol. Do not use solvents containing chloride or fluoride.

Note, If lapping cannot be performed the wedge or disc seating surface should be ground by a professional APV approved valve restorer.

5.8 SEATING FACES RE-LAPPING – WEDGE GATE AND PARALLEL SLIDE VALVES

a) If seating faces are damaged, the body seat must be corrected by lapping. Slight pitting, scratches or indentations no deeper than 0.1mm (0.005") can be removed by lapping. If defects cannot be corrected by lapping, the seats should be ground using specialised automatic grinding/lapping equipment. APV recommends a maximum of 0.4mm (0.015") per side that can be removed from 10° seated valve, and 0.25mm (0.010") per side on a 7° seated valve.

For parallel slide valves (see drawing example only Appendix B), a maximum of 1mm (0.040”) per seat can be removed. Consult a professional valve repairer. Grind the seat using automatic grinding equipment can save considerable time.

b) Where seat faces can be repaired using a lapping plate, the plate should be made of cast iron if possible and should be large enough to cover the face of the seat. Apply lapping compound mixed with olive oil and distribute over the plate.

6.0 REASSEMBLY

1. Re-assemble in reverse order of disassembly.
2. Bonnet bolts should be tightened in a diagonal pattern at several different increasing torque settings in accordance with the recommended torque value (see Table A, Appendix A and FIGURE 5).
3. Test in accordance with API 598.
4. When performing a body test ensure the valve is in the open position but not in backseat position. Tighten gland packing only just enough to prevent leakage without needing to employ the backseat. In this way it can be proven the packing is performing it’s task. Over-tightening the packing gland will increase wear and tear of the packing and can damage the gland, gland bolts or stem. If the valve is tight to turn with ease, loosen the packing gland slightly. The backseating can also serve to determine if the valve stem or backseat itself is damaged by slightly loosening the packing gland nuts. Remember, compressed graphite packing rings will not initially be decompressed when the packing gland is loosened but they will leak. Always keep the valve in the backseat position when re-tightening the packing.

Example only Typical Bolted Bonnet Gate Valve Exploded View

1. Disc
Flexible wedge is machined to the tightest tolerances to ensure trouble free shut off and cycling.

2. Stem
The stem is precision machined and inserts into the disc's horizontal channel.

3. Gland Packing
The packing creates a seal above the backseat, between the bonnet and stem.

4. Packing Gland
Compresses the packing to create a stem seal above the backseat, between the bonnet and stem.

5. Packing Gland Flange
Applies pressure to the gland for accurate packing adjustments.

6, 13 & 17. Gland Bolts, Nuts & Pin
The gland bolt and nut allows for easy adjustments for packing compression.

7. Seats
To ensure a stable shut off, seat rings are aligned and swaged into the valve, then precision ground for optimal seating.

8. Body
Cast steel bodies to ASME B16.34 & API 600.

9. Gasket
The bonnet gasket creates a leakproof seal between the body and bonnet.

10 & 18. Bonnet & Yoke
Bonnet assemblies are built to the same standards as the bodies. Larger size gate valve utilise 2 piece bonnet design.

11 & 11a. Bolts & Nuts
The bonnet bolts secure the bonnet to the body and where applicable (2 piece bonnet) the yoke to the bonnet.

12. Stuffing box
The stuffing box contains the packing.

14. Stem nut
The stem nut provides a precision guide for proper stem alignment.

15. Hand wheel
The hand wheel cycles the valve

16. Hand wheel nut
The hand wheel nut secures the hand wheel to the bonnet assembly.

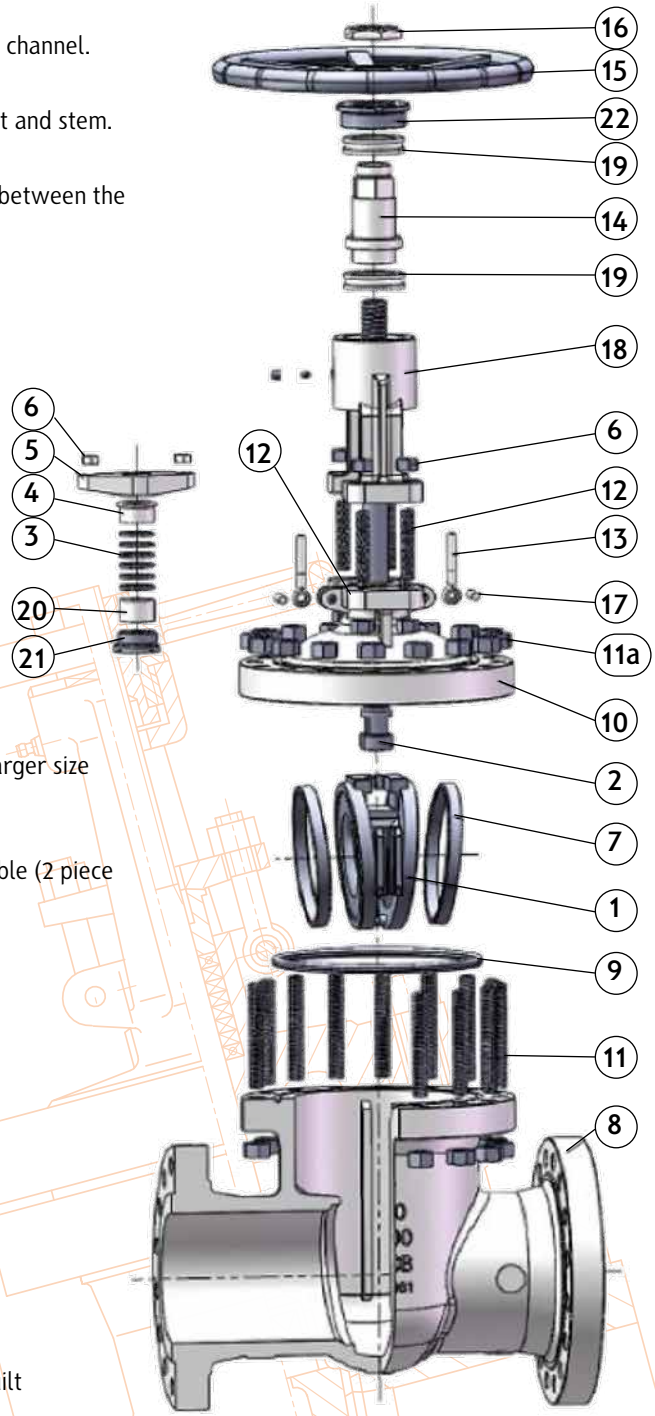
17. Bearing
Bearings for reduced torque.

20. Packing Ring/Space
Packing ring/spacers/lantern ring where applicable. (refer to as-built drawing).

21. Backseat
Backseat ring or can be integral/overlay backseat.

22. Handwheel Bearing Gland
Where applicable (refer as-built drawing).

FIGURE 4



2 Piece bonnet shown, smaller sizes use 1 piece bonnet. Refer to as-built drawing for pressure seal bonnet and 1 piece bonnet.

Sample only, refer to as built drawing as there are numerous designs for different sizes, classes, bonnet types and design standards

APPENDIX A

INDICATIVE BONNET BOLTING (BOLTED BONNET) TORQUE NM

TABLE A

STUD SIZE inch-TPI	Bolting Material		
	B7/B7M/B16/L7/L7M/ L43/660 Cl.A/UNS N07718/UNS 09925	B8 Cl.2/B8C Cl.2/B8M Cl.2/B8T Cl.2/XM-19	UNS N06625 Gr 1
1/4-20 UNC	7	7	5
5/16-18 UNC	15	15	10
3/8-16 UNC	25	25	15
7/16-14 UNC	40	40	25
1/2-13 UNC	60	60	40
9/16-12 UNC	90	90	60
5/8-11 UNC	120	120	80
3/4-10 UNC	215	215	145
7/8-9 UNC	345	315	230
1-8 UNC	520	475	345
1.1/8-8 UN	725	625	510
1.1/4-8 UN	1000	880	715
1.3/8-8 UN	1460	975	975
1.1/2-8 UN	1925	1285	1285
1.5/8-8 UN	2480	1655	1655
1.3/4-8 UN	3140	2090	2090

Note:

(1) Torque tolerance ±10%.
(2) For temperatures above 750°F (400°C) use 75% of the torque values. In high temperature services, there is a possibility of creep in the bonnet studs. Regular checking of the bonnet - studs for tightness, would help prevent leakage through the bonnet gasket.
(3) Above torque values are with the bolts lubricated.
(4) Values above are based on 206.85 Mpa/ 30,000 psi bolting stress and lubricated with heavy graphite and oil mixture or a copper based anti-seize grease.
(5) Do not exceed by more than 25% of values stated when emergency torquing is required.
(6) All bolts shall be torqued in the pattern as shown in Figure 5 on page 26 to ensure uniform gasket loading.
(7) Optimum torque can vary depending on type of body gasket but do not increase torque more than 10% above those shown.
(8) Consult us for other bolt material.
(9) Most B8M and B8 bolts are class 1 so do not assume class 2 unless you are sure. Refer to certificates or as-built drawing.

Note

Bolt tensions shown must be decreased by 25% when other or no lubrication used. Non lubricated bolts can have an efficiency of less than 50% the torque of values stated. Indicative torques are shown only, different body gasket systems, different sizes & classes, etc., will have different torque requirements. Furthermore, other stud grades can have much lower torques depending if class 1 or class 2 and or above variables.

APPENDIX A - CONT.

Note

For 'pressure seal' bonnet consult APV for torques (where bolting is applicable).

INDICATIVE WRENCH SIZE FOR BONNET BOLTING

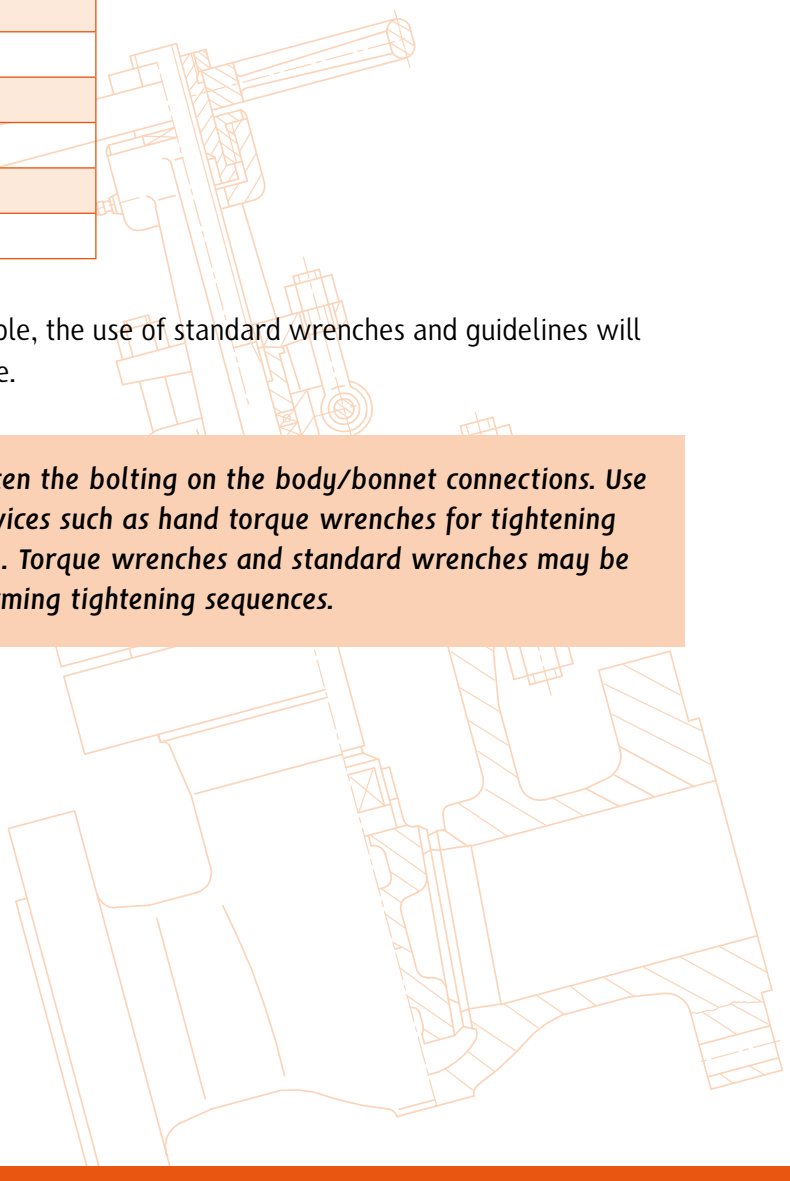
TABLE B

BOLT SIZE	LENGTH OF WRENCH (inches)
3/8"	125mm (5")
1/2"	150mm (6")
9/16"	225mm (9")
5/8"	300mm (12")
3/4"	450mm (18")
7/8"	600mm (24")
1"	750mm (30")
1-1/8"	900mm (36")
1-1/4"	1050mm (42")

When torque wrenches are not available or suitable, the use of standard wrenches and guidelines will apply to avoid over torque or damage to the valve.

Caution

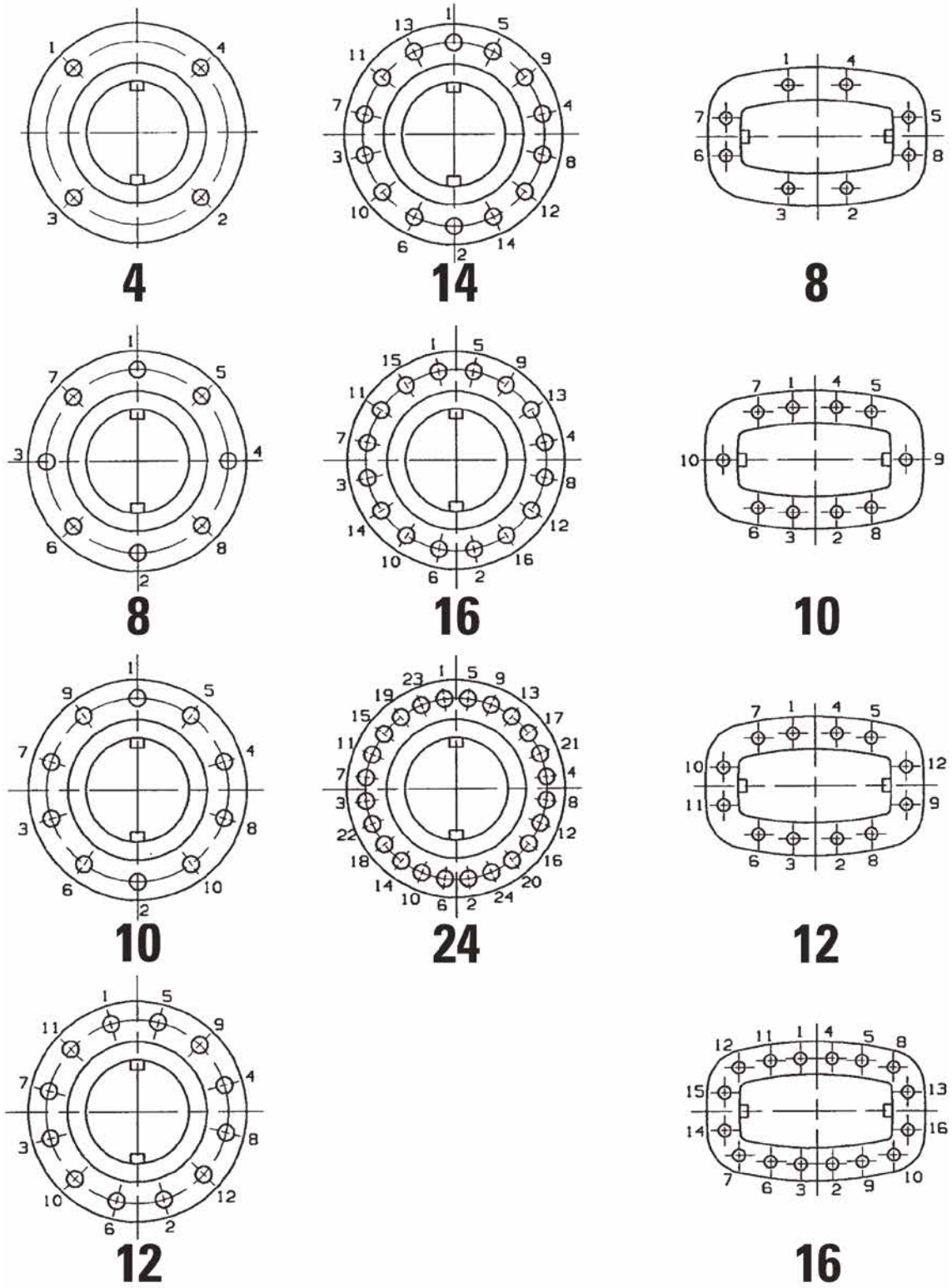
Never use impact devices to tighten the bolting on the body/bonnet connections. Use suitable designed mechanical devices such as hand torque wrenches for tightening and refer to Table A, Appendix A. Torque wrenches and standard wrenches may be used in combination when performing tightening sequences.



APPENDIX A - CONT.

BOLT TIGHTENING SEQUENCE

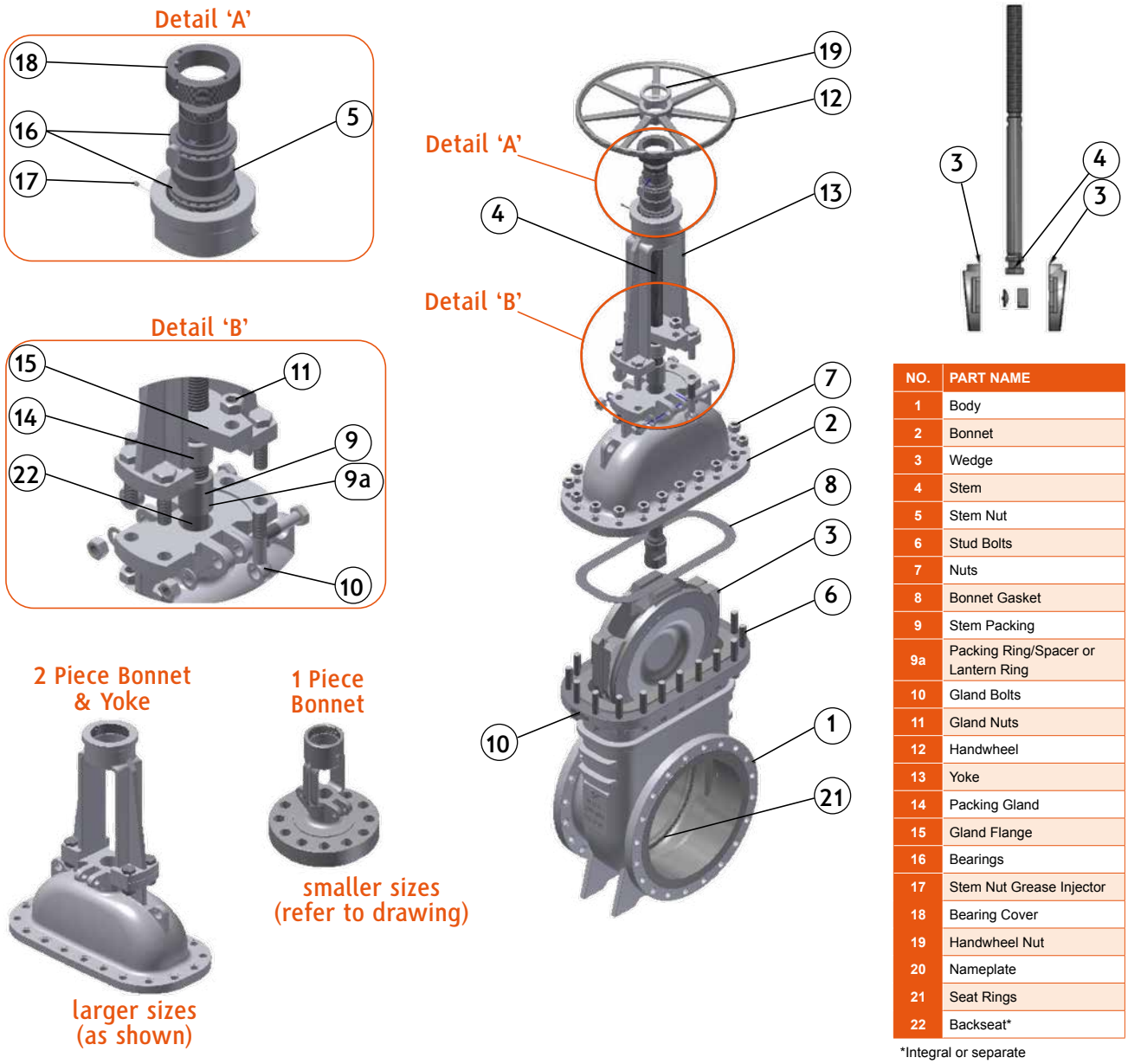
FIGURE 5



APPENDIX B

EXPLODED B.O.M.

FIGURE 6



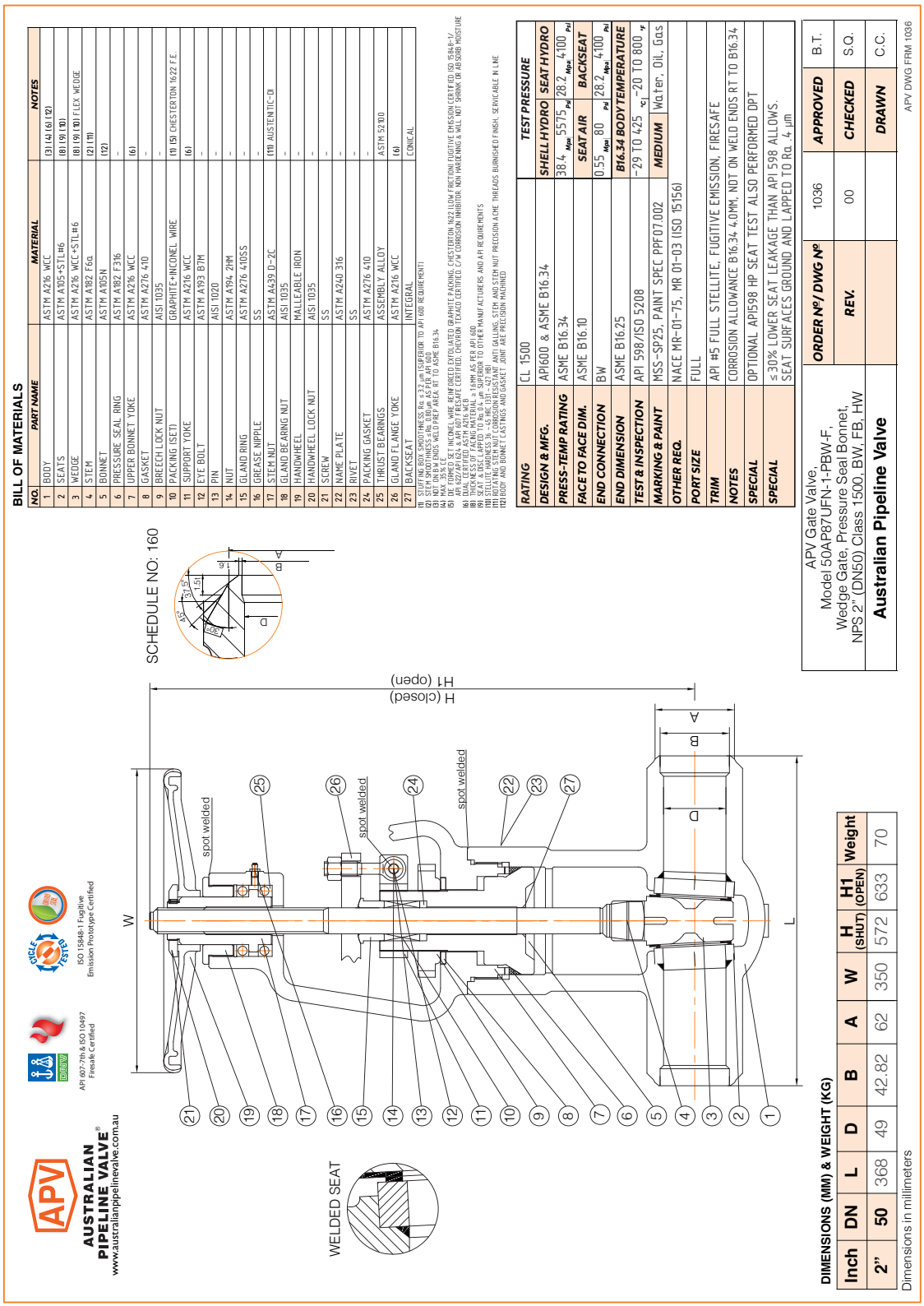
NO.	PART NAME
1	Body
2	Bonnet
3	Wedge
4	Stem
5	Stem Nut
6	Stud Bolts
7	Nuts
8	Bonnet Gasket
9	Stem Packing
9a	Packing Ring/Spacer or Lantern Ring
10	Gland Bolts
11	Gland Nuts
12	Handwheel
13	Yoke
14	Packing Gland
15	Gland Flange
16	Bearings
17	Stem Nut Grease Injector
18	Bearing Cover
19	Handwheel Nut
20	Nameplate
21	Seat Rings
22	Backseat*

*Integral or separate

Example only, refer to as-built drawing.

APPENDIX B - CONT.

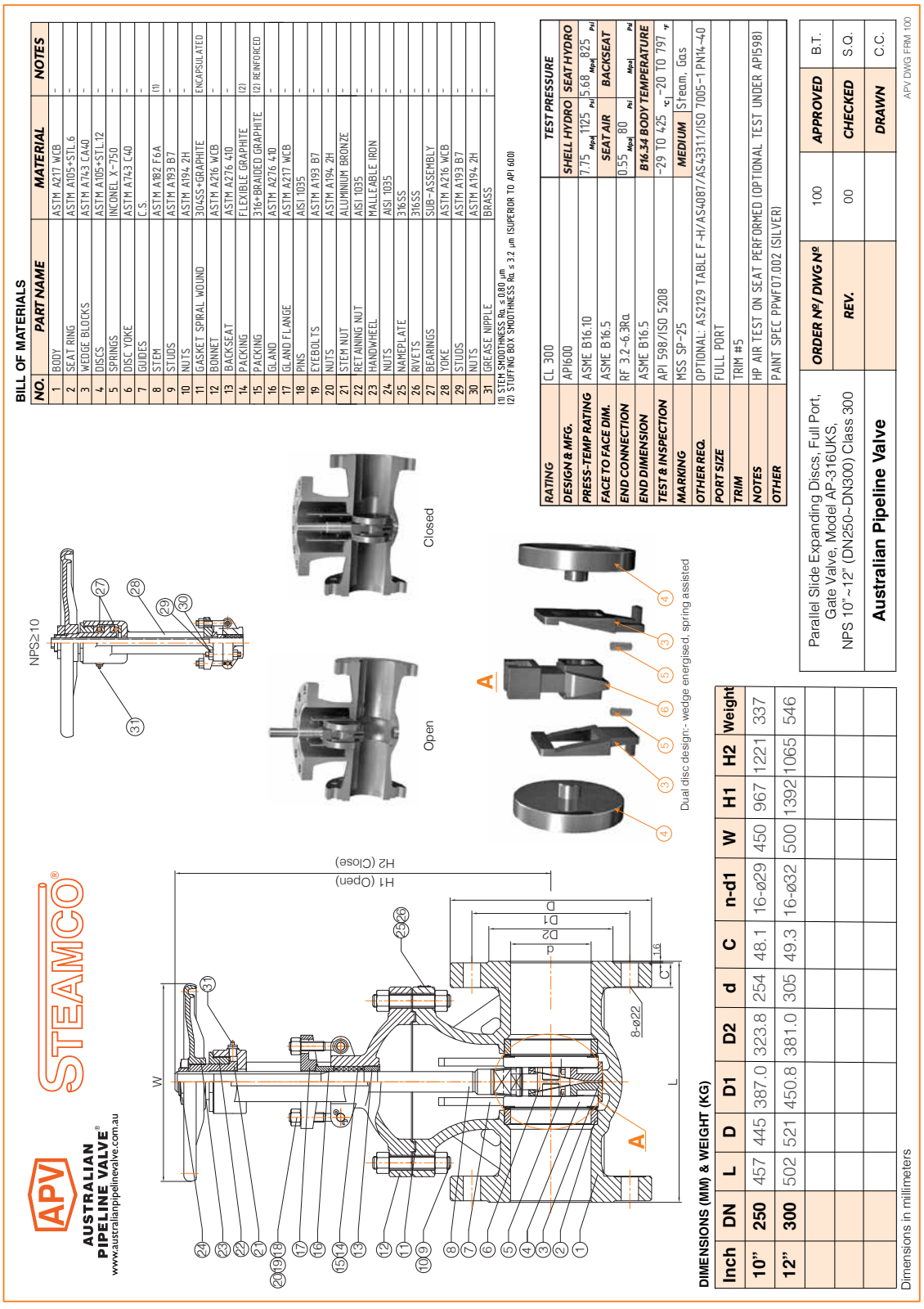
EXPLODED B.O.M. PRESSURE SEAL BONNET



Example only, refer to as-built drawing.

APPENDIX B - CONT.

EXPLODED B.O.M. PARALLEL SLIDE VALVE



BILL OF MATERIALS

NO.	PART NAME	MATERIAL	NOTES
1	BODY	ASTM A217 WCB	-
2	SEAT RING	ASTM A105+STL.6	-
3	WEDGE BLOCKS	ASTM A743 CA40	-
4	DISCS	ASTM A105+STL.12	-
5	SPRINGS	INCONEL X-750	-
6	DISC YOKE	ASTM A743 C40	-
7	GUIDES	C.S.	-
8	STEM	ASTM A182 F6A	(1)
9	STUDS	ASTM A193 B7	-
10	NUTS	ASTM A194 2H	-
11	GASKET SPIRAL WOUND	304SS+GRAPHITE	ENCAPSULATED
12	BONNET	ASTM A216 WCB	-
13	BACKSEAT	ASTM A276 410	-
14	PACKING	FLEXIBLE GRAPHITE	(2)
15	PACKING	316+BRAIDED GRAPHITE	(2) REINFORCED
16	GLAND	ASTM A276 410	-
17	GLAND FLANGE	ASTM A217 WCB	-
18	PINS	AISI 1035	-
19	EYEBOLTS	ASTM A193 B7	-
20	NUTS	ASTM A194 2H	-
21	STEM NUT	ALUMINUM BRONZE	-
22	RET.AINING NUT	AISI 1035	-
23	HANDWHEEL	MALLEABLE IRON	-
24	NUTS	AISI 1035	-
25	NAMEPLATE	316SS	-
26	RIVETS	316SS	-
27	BEARINGS	SUB-ASSEMBLY	-
28	YOKE	ASTM A216 WCB	-
29	STUDS	ASTM A193 B7	-
30	NUTS	ASTM A194 2H	-
31	GREASE NIPPLE	BRASS	-

(1) STEM SMOOTHNESS Ra ≤ 0.80 µm
(2) STUFFING BOX SMOOTHNESS Ra ≤ 3.2 µm (SUPERIOR TO API 600)

RATING	CL 300	TEST PRESSURE	
DESIGN & MFG.	API600	SHELL HYDRO	SEAT HYDRO
PRESS-TEMP RATING	ASME B16.10	7.75 Mpa 1125 Psi	5.68 Mpa 825 Psi
FACE TO FACE DIM.	ASME B16.5	SEAT AIR	BACKSEAT
END CONNECTION	RF 3.2~6.3Ra	0.55 Mpa 80 Psi	Mpa Psi
END DIMENSION	ASME B16.5	B16.34 BODY TEMPERATURE	
TEST & INSPECTION	API 598/ISO 5208	-29 TO 425 °C	-20 TO 797 °F
MARKING	MSS SP-25	MEDIUM	Steam, Gas
OTHER REQ.	OPTIONAL: AS2129 TABLE F-H/AS4087/AS4331.1/ISO 7005-1 PN14-40		
PORT SIZE	FULL PORT		
TRIM	TRIM #5		
NOTES	HP AIR TEST ON SEAT PERFORMED (OPTIONAL TEST UNDER API598)		
OTHER	PAINT SPEC PPWF07.002 (SILVER)		

Parallel Slide Expanding Discs, Full Port, Gate Valve, Model AP-316UKS, NPS 10"~12" (DN250~DN300) Class 300

ORDER Nº/ DWG Nº	100	APPROVED	B.T.
REV.	00	CHECKED	S.Q.
		DRAWN	C.C.

Australian Pipeline Valve

APV DWG FRM 100

NPS≥10

Closed

Open

Dual disc design:- wedge energised, spring assisted

DIMENSIONS (MM) & WEIGHT (KG)

Inch	DN	L	D	D1	D2	d	C	n-d1	W	H1	H2	Weight
10"	250	457	445	387.0	323.8	254	48.1	16-ø29	450	967	1221	337
12"	300	502	521	450.8	381.0	305	49.3	16-ø32	500	1392	1065	546

Dimensions in millimeters

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Example only, refer to as-built drawing.

APPENDIX C

FIGURE NUMBER SYSTEM

EXAMPLE 150AP125QTISN-9PBWG-FA

150	AP125	QTI	S	N	-	9	PL	BW	G	-	F	A

A *Bonnet gasket:* **Blank** *Standard:-* SS + GRP (BB), Pressure Seal Ring (PSB). *N/A:-* (WB). **A** SS + PTFE **B** S31803 Spiral **C** PTFE **D** SS + PTFE + GRP **E** Ring **L** Live Loaded **Z** Special

F *Stem packing:* **Blank** *Standard:-* Graphite. *N/A:-* (Check Valves) **L** Graphite + PTFE **T** PTFE **F** Fugitive Emission GRP **I** Fugitive Emission PTFE **J** Special

Denotes special suffix - Packing/Gasket

Operator: **Blank** Handwheel or N/A **A** Actuator **G** Gear **H** Hammer Blow Handwheel

End connection: **Blank** RF (B16.5) **BA** RF B16.47A (MSS SP44) **BB** RF B16.47B (API 605) **RJ** RTJ **BW** Buttweld **FF** Flat Face **SP** is special drilling **UD** Undrilled **UM** Unmachined for RF/RJ

Bonnet: **Blank** Bolted **C** Cryogenic **H** Pillar & Bridge **L** Low Temperature **P** Pressure Seal **S** Bellows Sealed **W** Welded

Body material: - see page 5. (WCB is Blank)

Denotes special suffix - Body/Bonnet/Ends/Operator

Blank Non NACE **N** NACE

Blank Standard Configuration (Example Solid Wedge) **A** S Bend Globe **D** Globe-Stop Check **DG** Globe - Stop Check Guided **F** Flexible Disc Gate **J** Slab Gate **K** Expanding Gate **L** Lever (Swing Check) **P** Full Opening Swing Check (API 6D) **Q** Full Opening Piston Check (API 6D) **R** Right Angle **S** Parallel Slide **Y** Inclined Bonnet **Z** c/w Spring

Denotes trim - Code & Modifier (see below)

Basic identifier number denoting valve class and valve type (As shown in catalogue)

Valve Size

TRIM CODES

		BODY SEAT SURFACE	DISC SURFACE	STEM	BACK SEAT (STUFFING BOX)
TRIM CODE(1)	B	Bronze	Bronze	Bronze	Bronze
	C	AL-Bronze	AL-Bronze	AL-Bronze	AL-Bronze
	D	Monel(1)	Monel(1)	Monel	Monel
	E	F51(1)	F51(1)	F51	F51
	G	F55(1)	F55(1)	F55	F55
	H	Hastelloy B(1)	Hastelloy B(1)	Hastelloy B	Hastelloy B
	L	F316(1)(6)	F316(1)(6)	F316(6)	F316(6)
	M	F316L(1)	F316L(1)	F316L	F316L
	N	Alloy 20(1)	Alloy 20(1)	Alloy 20	Alloy 20
	P	F304(1)	F304(1)	F304	F304
	Q	F304L(1)	F304L(1)	F304L	F304L
	R	Alloy 625(1)	Alloy 625(1)	Alloy 625	Alloy 625
	V	F53(1)	F53(1)	F53	F53
	W	F347(1)	F347(1)	F347	F347
	Blank	F6a/F6/410	F6a/F6/410	F6a/F6/410	F6a/F6/410
	Z	Special(1)	Special(1)	Special	Special
MODIFIER	EN	ENP	ENP	(2)	(2) (3)
	GE(5)	Stellite #6	Stellite #12	17-4 PH	Stellite #6
	I	-	-	17-4 PH	-
	M	-	-	Monel	-
	T	+PTFE Seat	-	-	-
	U	Stellite	Stellite	(2)	(2) (3)
	X	(4)	(4)	(4)	(4)
	XU	Stellite	(2)	(2)	(2) (3)
	Z	-	-	Special	-

(1) Add modifier below if applicable. **(2)** As per trim code above. **(3)** Or Integral as per body. **(4)** API trim code #1 only. (5) Geothermal trim. (6) Can be dual certified 316/316L.

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NOTES

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