



School of Engineering MSc Mechanical Engineering

Engineering Design and Analysis – M7X01379
Assignment 2 – The Application of an Engineering
Design Methodology – Industrial/Commercially
Available Product

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Abstract

The assignment considers the suitability of the Klinger Type D isolation valve for the isolation of boiler water level gauge glasses under operating conditions where maintenance is required. The isolation problem is analysed using root cause analysis tools and the valve is redesigned in line with the 'Serviceability' elements of 'Design for 'x' – drivers for change'. A conceptual assembly CAD model and technical drawing are provided for consideration.

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1.0 Introduction

The Klinger D type isolation valve utilised on water level gauges of a shell boiler is considered for redesign in line with the 'Design for 'x' – drivers for change' methodology. Due to the valve being unsuitable for service in certain operating scenarios where isolation and maintenance is required while the associated boiler is still at pressure and temperature.

The background to the problem is reviewed, where statutory obligations regarding compliance with requirements of the Health and Safety at Work Act and successful prosecution for breach has resulting in the user taking a complete shutdown approach to maintenance activities which in turn results in lost production.

The isolation problem is analysed using root cause analysis tools, where a double block and bleed arrangement is identified as the redesign consideration. A conceptual design is proposed on the outcome of a design assessment for modelling in a CAD environment. The final design proposal and CAD model meets with the identified requirements for isolation, a further set of technical drawings is provided for consideration in addition to this report.

The final design incorporates a secure double block and bleed isolation arrangement which meets the requirements recommended in enforcing authority best practice as a way of demonstrating compliance with statutory obligations.

2.0 Problem Background

Industrial shell boilers are used extensively in manufacturing facilities where there is a need for low pressure saturated steam for process heating purposes. Historically, boiler installations were designed with a level of redundancy, typically specifying more than one boiler. Such configurations allowed for routine and non-routine maintenance activities to be completed with the boiler off line and suitably isolated from the rest of the live system. One such routine activity is the maintenance associated with water level gauge glasses, which give a direct indication of the water level within the boiler shell.

The standard gauge glass frame and isolation assemblies consists of a single point of isolation, for functional purposes to allow testing and verifying of the level under normal operation, and, isolation for maintenance during use, either glass replacement due to breakage or leakage of the sealing joint. Figure 1 describes a typical gauge glass arrangement on a shell boiler.

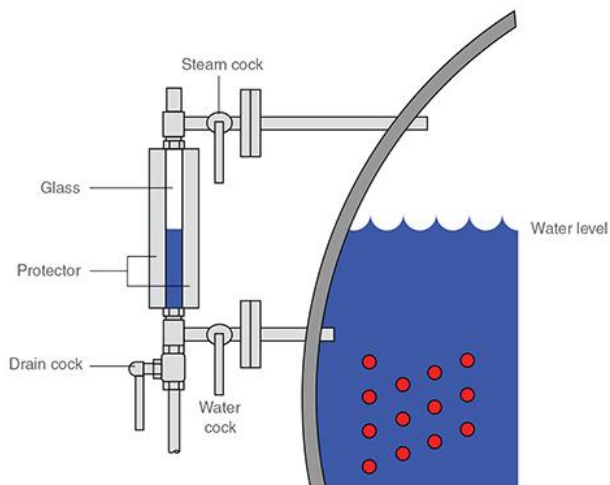


Figure 1. Typical single isolation gauge glass arrangement (Spirax, 2019)

With an ever-increasing focus on financial constraints in new installations, which typically results in the minimum number of boilers being specified to meet the needs of the plant. In many cases this is a single boiler that runs continuously between planned maintenance periods. A problem arises in the safe management of non-routine maintenance, specifically regarding water level gauge glasses.

Whilst the design of shell boilers and associated water level instrumentation has remained consistent in accordance with respective design codes such as BS 2790: 1992 Specification for design and manufacture of shell boilers of welded construction, and BS 759: Part 1: 1984 Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. And more recently the BS EN 12953 series regarding shell boilers, specifically Part 6: Requirements for

equipment for the boiler (BS EN 12953-6:2011). There is no specific emphasis on the isolation requirements of instrumentation other than a means of isolation is present.

The single point of isolation for routine maintenance can cause compliance issues for the duty holder under the Health and Safety at work Act 1974, specifically regarding the implementation of safe systems of work on live pressure systems where both routine and non-routine maintenance is required. This was highlighted in an immediate prohibition notice issued in 2012 against Kettering General Hospital NHS foundation Trust by the Health and Safety Executive where it was found that there had been a failure to provide adequate provision for isolation and no safe system of work (HSE, 2019). The trust was later fined £7000 and incurred additional costs after pleading guilty to a breach of Section 2(1) of the Health and Safety at Work Act 1974 at Northampton Magistrates Court. It was heard that an employee received significant burns due to the release of steam back through a single point of isolation where work was being undertaken (Quantum Compliance, 2019).

The position of the Health and Safety Executive regarding pressure isolation is further confirmed in their guidance document HSG253 The safe isolation of plant and equipment (HSE, 2006). Such documents issued by the Health and Safety Executive are considered good practice and following as such normally ensures compliance (HSE, 2006). The guidance cites instrumentation maintenance as one routine reasons for working on pressurised equipment (HSE, 2006).

Application of the guidance contained within HSG253 The safe isolation of plant (HSE, 2006) determines the baseline isolation standard for a water level gauge as a category II proved isolation, as steam is classed as a category 2 hazardous substance under these guidelines the recommended isolation is of as double block and bleed valve arrangement, further described in figure 2.

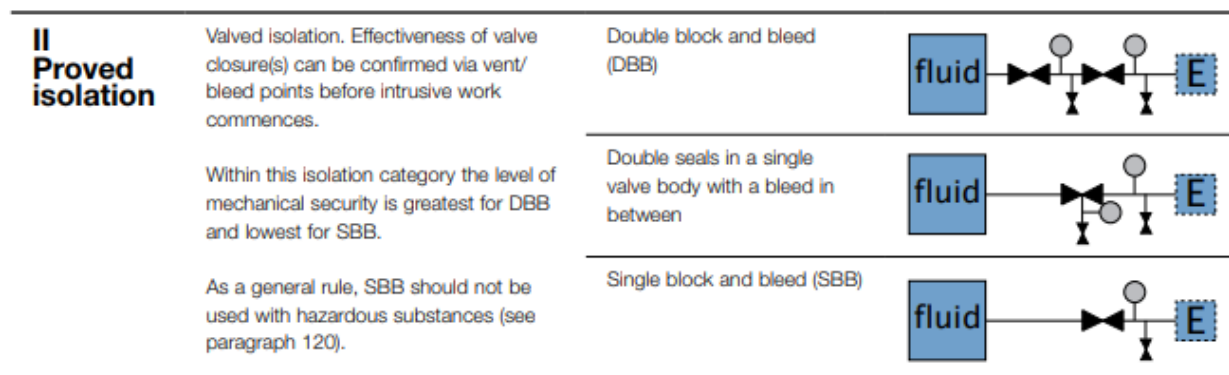


Figure 2. HSG253, Category II Proved Isolation (HSE, 2006)

A further important statutory consideration regarding the operation and maintenance of shell boiler with significance to the duty holder is the Pressure Safety Systems Regulations 2000, this is concerned with danger which arises as the result of the unintentional release of stored energy and the scalding effects of steam.

Therefore, duty holders responsible for the operation and maintenance of single installation shell boilers are increasingly faced with significant production delays and the costs incurred as a result of a total system shutdown where non-routine maintenance of boiler water level gauge glasses are considered. Such total system shutdown being required as a result of a risk assessment where identified risks are reduced to as low as reasonably practicable. Whilst also demonstrating compliance with the requirements of statutory legislation and Health and Safety Executive guidance.

3.0 Analysis of the problem

The problem of safe isolation of water level gauges on shell steam boilers is analysed using the following described problem-solving techniques to identify the root cause of the problem. Clear identification allows an appropriate product design specification to be developed.

The overall procedure of safe isolation of the boiler plant is considered using a cause and effect diagram, to establish the categories and effects that are applicable to the isolation process. The cause and effect diagram or fishbone diagram is detailed in figure 3. The diagram confirms that the equipment and policies and procedures categories are instrumental in addressing the problem and providing a suitable solution. The people and environment categories were not considered to contribute directly to the problem as the level of training and understanding with boiler plant is of a good standard, the problem identified by review of literature being the method of isolation.

To test the above conclusion a 'five why's' analysis considering the same problem was completed, the process and findings are listed in figure 4. The analysis concludes that the isolation is not possible due to the correct valve being unavailable which meets the required procedures.

The outcome of the cause and effect analysis and the five why's analysis both confirm that the equipment as in the available design of isolation valve, and policies which direct isolation procedures are the root cause of the isolation problem. As compliance with policy and legislation is mandatory and not subject to review or change by the user. Any suggestion or proposal concerning amending compliance in a negative manor would be considered unethical. Therefore, the remaining and only viable option in consideration of a solution to the problem is in the redesign of the valve to ensure that it meets the expected serviceability requirements of the user.

A design failure mode and effect analysis is completed on the existing single spindle valve to establish the risk priority number for identified potential failure modes and is detailed in figure 5. The current single spindle valve arrangement scored a Risk Priority Number (RPN) of 900 in the worst case where the valve was inadvertently opened during a maintenance function. The RPN for scenarios where the isolation failure occurred due to the valve passing was found to be 540. The proposed recommended action of incorporating a lockable double block and bleed arrangement in the isolation valve reduced the RPN to 10 and 60 for the respective scenarios discussed.

Cause and Effect (Fishbone) Diagram

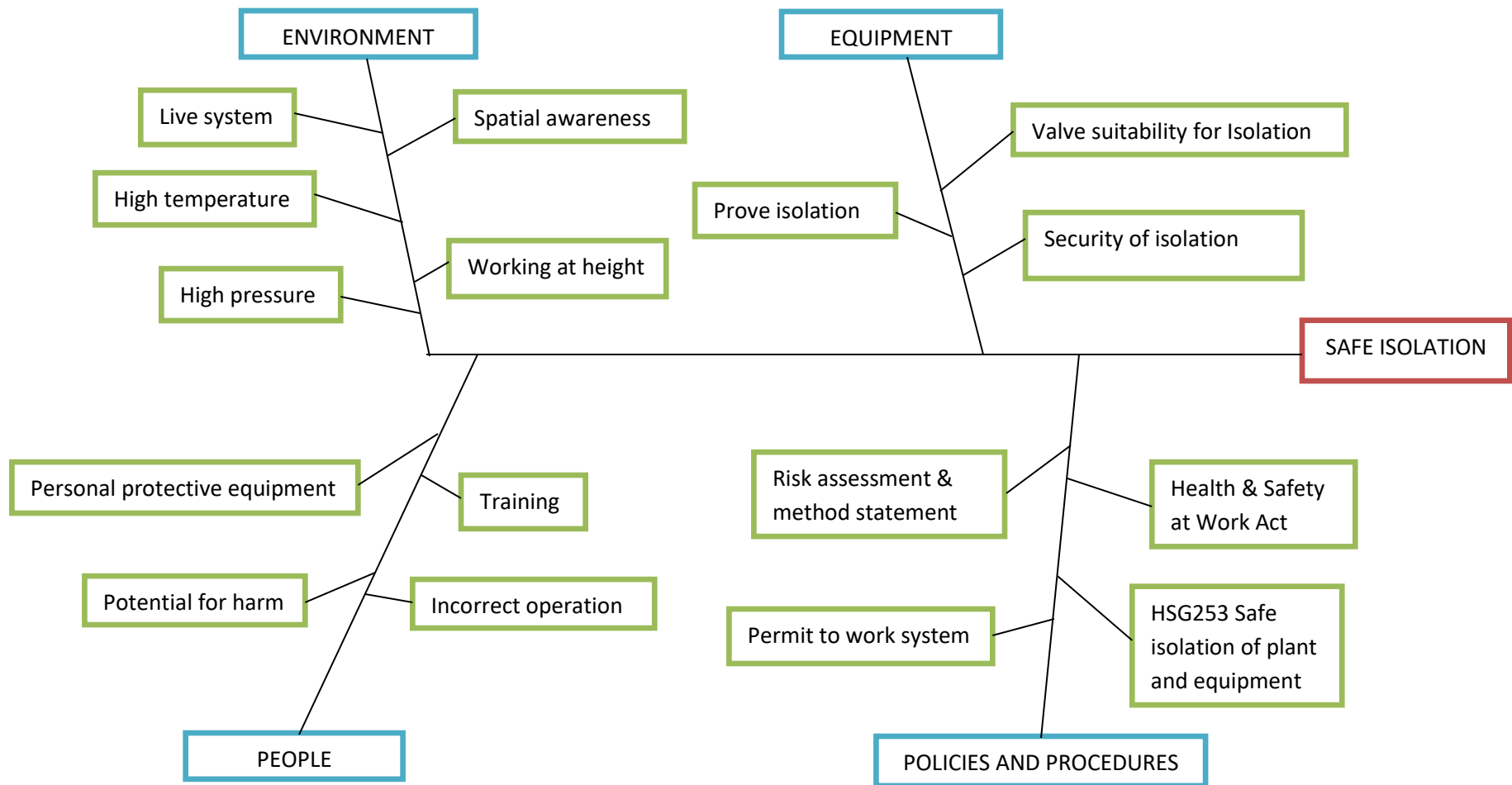


Figure 3. Cause and Effect (Fishbone) diagram - Categories and causes which affect safe isolation

Five Why's? Analysis

Why		Answer
1	Why is it no possible to complete gauge glass maintenance during boiler operation?	User policy and procedure require that the exposure to risk during completion of the task is reduced to as low as is reasonably practicable.
2	Why is it not possible to reduce the risk during completion of the task to as low as is reasonably practicable?	User follows the guidance contained within HSG253 The safe isolation of plant and equipment issued by the Health and Safety Executive in demonstrating their compliance with their obligations set out in the Health and Safety at Work Act 1974. The level of isolation recommended within HSG253 is not possible during operation.
3	Why is it not possible to achieve the isolation recommended within HSG253?	The boiler system contains steam which is classed as a class 2 hazardous substance under HSG253 which recommends a baseline isolation standard of category II proved isolation, with a further recommendation that the isolation is of a double block and bleed valve arrangement. The current gauge glass isolation is of a single block and bleed arrangement only.
4	Why is the current isolation of a single block and bleed arrangement only?	The current block and bleed arrangement is suitable for functional operation and testing only, maintenance requires a system shutdown. Online maintenance would require an isolation of the double block and bleed arrangement.
5	Why is the boiler not fitted with gauge glass isolation of the double block and bleed arrangement, to allow online maintenance to be undertaken?	The supplier of the gauge glass assembly and isolation valve only have a single block isolation arrangement available, this is also the case for competitors.

Figure 4. Five Why's analysis of gauge glass isolation problem

Design Failure Mode and Effect Analysis

DESIGN FAILURE MODE AND EFFECTS ANALYSIS														
Item: Single Spindle Isolation		Responsibility:												
Model: Type D Valve		Prepared by:												
Core Team:														
Process Function	Potential Failure Mode	Potential Effect(s) of Failure	Sav	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detect	RPN	Recommended Action(s)	Action Results			
											Sav	Occ	Det	RPN
Live System Isolation	Valve inadvertently opened during maintenance	Scalding to operator	10		No lock facility on valve	9	Permit to work system	10	900	Incorporate lock facility to valve	10	1	1	10
	Isolation failure, upper and lower valve assembly	Scalding to operator	10		System fluid passing gland packing	6	None, single point of isolation	9	540	Replace valve for double block and bleed arrangement	10	1	6	60
	Isolation failure, upper valve assembly	Scalding to operator	10		System fluid passing gland packing, Unable to prove isolation	6	None, single point of isolation, no proving drain/vent	9	540	Replace valve for double block and bleed arrangement	10	1	6	60

Figure 5. Design Failure Modes and Effect Analysis – Single spindle valve

4.0 Product Selected for Redesign

To address the problem of safe isolation utilising the double block and bleed method the Klinger D type gauge isolation valve which forms part of the Klinger Reflex gauge glass assembly will be redesigned in line with 'Serviceability' element of Design for 'X' – drivers for change'.

Figure 6 details a typical gauge glass assembly. The assembly consisting of the reflex R25 gauge frame (Klinger, 2019), blow down valve, and top steam and bottom water isolation valves of the Klinger D pattern (Klinger, 2019).



Figure 6. Klinger Reflex Gauge Assembly (Klinger, 2019)

The D type isolation valve detailed in figure 7, supplied by Klinger is single isolation only (Technical specification - Appendix 1). Also, other Klinger valve configurations available which are compatible with the gauge frame (Technical specification - Appendix 2) are of the single isolation arrangement, therefore it is not possible to establish a double block arrangement with the standard valve range and meet the safe isolation requirements as discussed earlier, where the boiler is operating under pressure and the gauge glass requires exchange due to breakage or seal leakage.



Figure 7. Klinger D Type Isolation Valve (Klinger, 2019)

5.0 Product Design Specification

The valve will be identified as the Klinger D-DB type valve. The following elements of the product design specification details the principle requirements of the valve to address the problem.

Performance

- Achieve full double block and bleed isolation in accordance with HSG253
- Rated to ANSI 400, PN 64
- Meet requirement of BS 759

Dimension and weight

- Valve assembly to remain within original specification in width and breadth
- Valve assembly overhaul height not to exceed 2x original specification
- Assembled valve weight not to exceed 2x original specification

Materials

- Valve body – Forged Carbon Steel ASTM A105
- Use standard parts list where possible for valve components

Environment

- Corrosion protection suitable for normal working environment
- Operation by trained personnel
- Process fluid steam and high temperature hot water
- Process fluid treated with corrosion inhibitor and oxygen scavenger
- Operating temperature range: 0 – 236 °C
- Operating pressure range: 0 – 30 barg

Legal

- Potential litigation due to user injury from hot surfaces
- CE marking requirements in accordance with the Pressure Equipment Directive

Safety

- Must achieve isolation in accordance with the recommendation contained within HSG253
- Baseline isolation standard of category II proved isolation required, of the double block and bleed arrangement
- Facility to attach isolation lock in the isolated valve position to satisfy permit to work and isolation system requirements

Documentation

- The valve assembly to be supplied with declaration of conformity and instructions written in English

Disposal

- Component parts of valve assembly must be recyclable. This should be achieved through routinely available recycling facilities
- Product packaging should be recyclable

User Requirements

- Must be interchangeable with existing gauge frames from same manufacture

Ergonomics

- Valve movement to be achieved by a single operator
- One handed operation
- All functions possible whilst wearing normal PPE

Reliability

- Valve assembly should require only annual maintenance, any other repairs/adjustment considered non-routine

Service Life

- Valve assembly should not require replacement within a five year period
- Routine operation expected 3 full service operations in one 24 hour period. 2 full isolation operations in 50 week period

Shelf Life

- Valve assembly should have storage shelf life of 2 years

Manufacture

- Valve should use standard parts where available
- Utilise existing single isolation machine tooling where possible
- Does production volume justify permanent or temporary tooling

Aesthetics

- Valve body and gland components to be finished with standard valve body coating, high temperature aluminium coating
- Valve handles to be sleeved with injection moulded handle covers

Constraints

- Additional tooling required for change in design.

Competition

- Literature review focusing on competitors' products and current patents.

Quantity Volume

- UK market in order of 20k boiler installations, product predominantly aimed at UK market due to legislation requirements.
- Potential developed world market for product where increased focus on safe operation of process plant.

6.0 Conceptual Design

The following conceptual designs detail the proposed redesign of the existing valve body of the Klinger D type gauge isolation valve with consideration of the developed Product Design specification.

The designs are visualised without the associated boiler mounting flange, as the mounting is available in several options, namely flange specification and weld neck or screw mounting. There is no requirement to alter or amend the boiler mounting arrangement, or the gauge mounting arrangement which is required to remain standard across the valve range.

6.1 Design 1 – Single Spindle

The valve body remains within the original design limits of length and breadth, inclusive of additional material for a handle stop. The depth of the valve body is increased on the lower face with additional material added. This allows the fitting of a further valve which proves the bleed isolation space, this acts as a tricock arrangement in proving the isolation. The valve spindle and gland follower and drain valve are standard parts.

Gland packing will require modification away from the standard part to allow inclusion of an additional port to allow proving of the bleed isolation space. This is not ideal in line with the product design specification and the use of standard parts. The pressed steel handles require additional material to allow the formation of the rotation stop, which is common to both design proposals.

Additional machining is required in the way of the lower drain port and isolation lock hole.

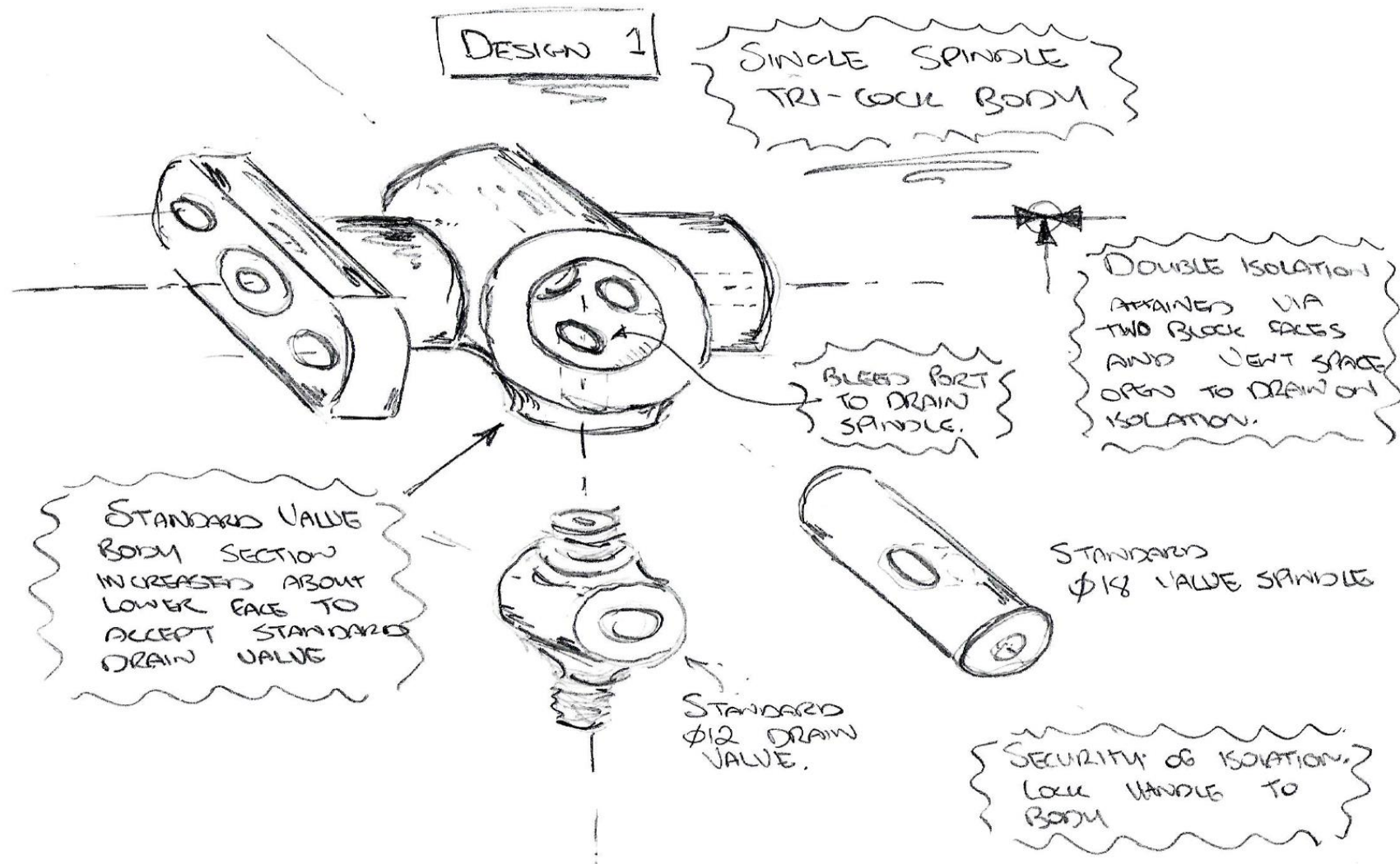
6.2 Design 2 – Double Spindle

The single spindle valve body is increased in length to allow the addition of a second valve spindle and gland chamber along with a bleed space to allow proving of the isolation. There is no increase in the overall depth and the handle stop is contained within the original design breadth. The overall weight should not exceed the specification as spacing between the spindle centres is expected to be in the order of twice the depth.

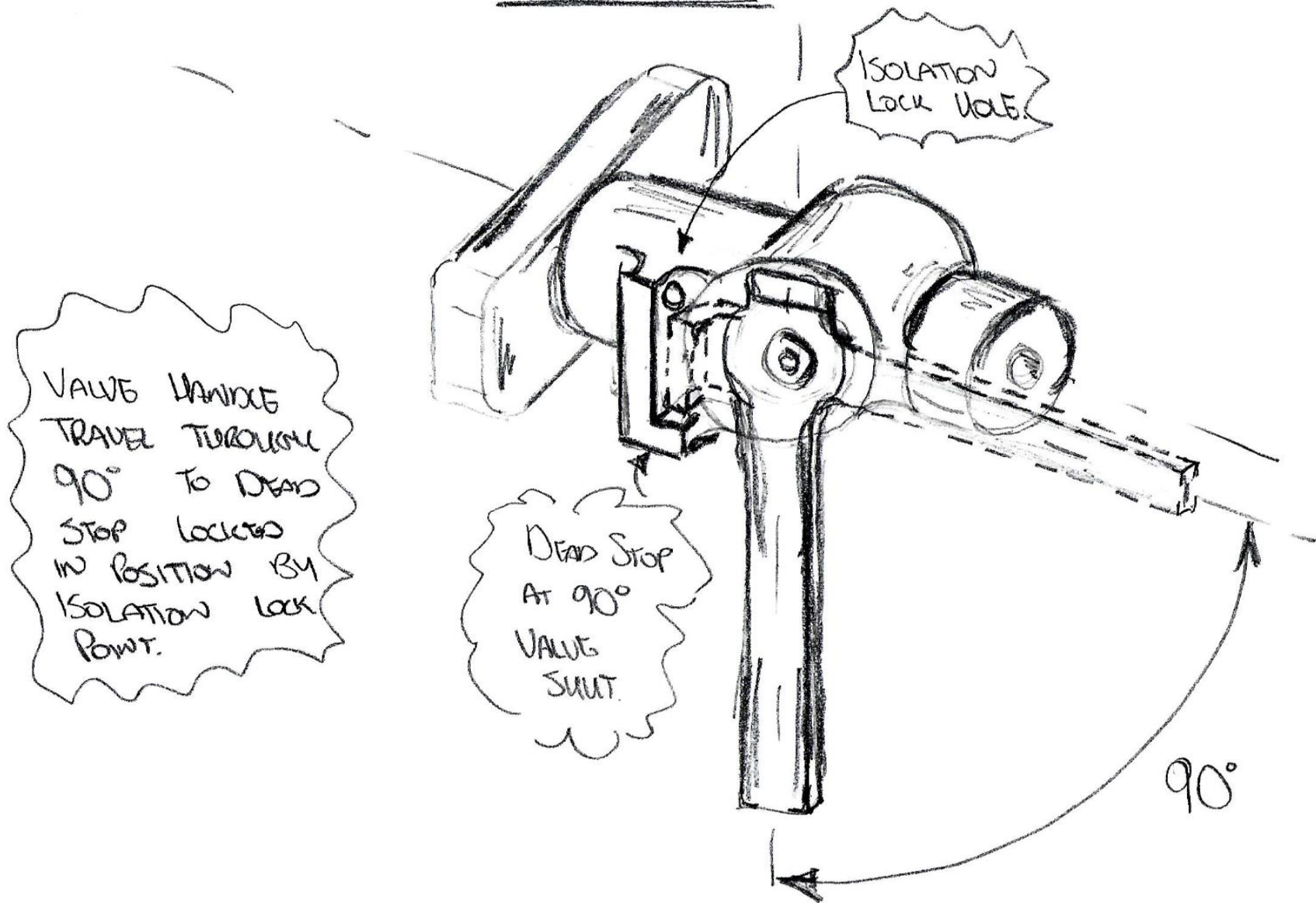
The valve spindles, gland packing, followers and drain valve are standard parts and require no modification. The valve isolation handles are of pressed steel as design 1 and would also require modification, however it is envisaged that the valve handle would be the same in both cases.

Additional machining is required in the way of the second valve pocket, which is of the same pattern as the original, machined from the same side. Also, the lower drain port and isolation lock hole.

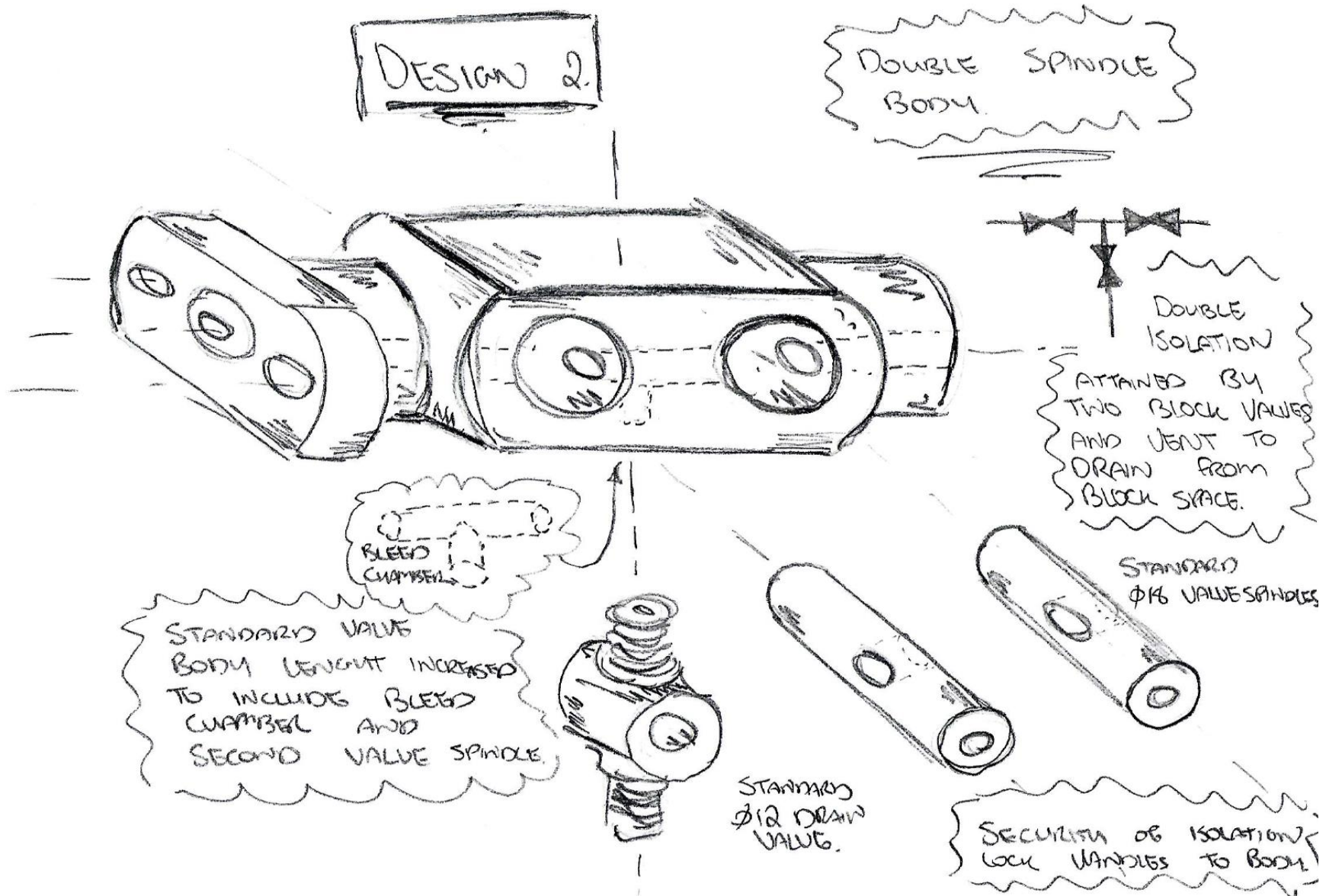
6.3 Conceptual Sketch 1 - Design 1



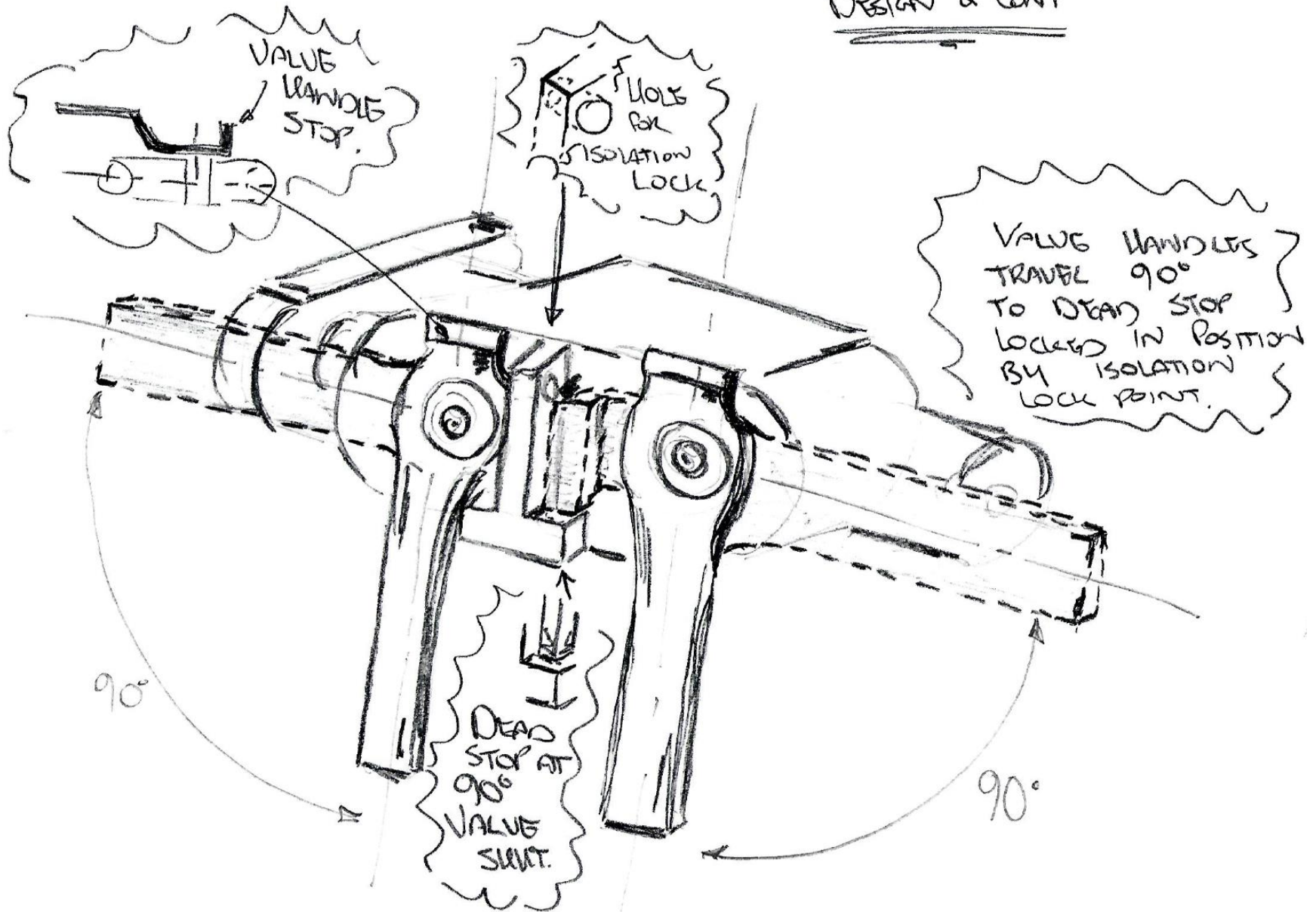
DESIGN 1 CONT



6.4 Conceptual Sketch 2 - Design 2



DESIGN 2 CONT



7.0 Concept Design Evaluation

The proposed conceptual designs are evaluated using the rating/weighting method of evaluation against the product design specification criteria. The rating/weighting matrix is helpful in evaluating concept designs where non-quantifiably parameters are present and strong product precedence exists (Pugh, 1991), such as the user requirements and performance, also the design is well understood and accepted, however it fails on compliance with modern safety recommendations. The matrix evaluation omits elements of the product design specification which are considered equal between proposals. The elements are given a weighting of between 1 and 5, where a weighting score of 5 is considered of high importance in meeting the design criteria.

Rating/Weighting Matrix - Evaluation Concept Valve Design 1-2

Criteria Analysis			Rating		Weighting x Rating	
			Design 1 - Single Spindle	Design 2 - Double Spindle	Design 1 - Single Spindle	Design 2 - Double Spindle
PDS Requirements	Performance	5	4	5	20	25
	Dimmension/Weight	3	5	3	15	9
	Safety	5	4	5	20	25
	User Requierments	3	5	3	15	9
	Reliability	4	3	4	12	16
	Manufacture	4	4	3	16	12
	Service life	3	3	5	9	15
	Ergonomics	3	4	4	12	12
			Total		119	123
			Rank		2	1

7.1 Design 1 – Single Spindle

The single spindle design scored a total of 119 in the rating/weighting evaluation. The maximum score was achieved against the dimension/weight and user requirement elements as the valve assembly would keep the existing overall dimensions as the original single isolation design. This would have minimal impact on the user as the valve would be considered as a like for like replacement, fitting within the original assembly envelope.

The design failed to score the maximum weighting on performance and safety due to the possibility of the double isolation failing where the system fluid was able to pass across the gland packing due to wear. This scenario is also reflected in the reliability and service life score, as the valve depends on a single spindle and gland to perform routine operation functions and isolation. Frequent routine operations reduce the sealing performance of the gland packing, which in turn exposes the integrity of the isolation element sealing function. Which potentially could result in non-routine maintenance of the valve assembly.

The single valve assembly also failed to score the maximum weighting when considering the manufacture and ergonomics element. Whilst the manufacturing process would require modest changes to deliver the design changes, the gland packing component would require redesign to incorporate the additional vent port. The ergonomics were not improved on the original design due to the use of existing parts and valve orientation to meet the user and dimension requirements.

7.2 Design 2 – Double Spindle

The double spindle isolation ranked in first place with a rating/evaluation score of 123. Whilst the design scored lower on rating for dimension/weight and user requirements than design 1, the design drew the maximum weighting for performance and safety. The double spindle proposal fully meets the specification for double block and bleed isolation, by utilising two independent valve chambers with an interconnected bleed section. The problem of possible bypass across the valve gland packing and failure of isolation is mitigated by incorporating the second valve spindle. It is envisaged that the inner valve is used for isolation purposes only, with the outer spindle providing both an operational and isolation function.

The lower weighting attributed to dimension/weight and user requirements is due to the overall length of the valve assembly increasing to accommodate the additional spindle section. Whilst the product design specification requires that the valve is compatible with the gauge glass that forms the completed

assembly, it is acknowledged that the increase in length may exceed the design footprint of the boiler that the assembly is fitted on.

The ergonomics were not improved in the design as the same criteria apply for design 1, however consideration was given to the addition of the second isolation spindle and handle location. To maintain consistency across the range the isolation functions were retained on the opposite side of the valve body to that of the drain and vent function, in all cases the vent/drain valve being in the lower position.

8.0 Conceptual Design Outcome

The conceptual sketch which is taken forward for development within the CAD environment is Design 2 consisting of the double spindle as this conceptual design scored the highest during evaluation. A solid model is created using Solidworks Student Edition, academic year 2018-2019, the final solid model also being represented by a set of dimensioned technical drawings.

Figures 8 and 9 show the completed valve assembly solid model in a transparent view with an associated PN40 DN25 flange for information and comparison with the conceptual design sketch 2.

Figure 10 shows the valve in the closed position, with the isolation handles against the stops, which in turn can be secured with an isolation lock.

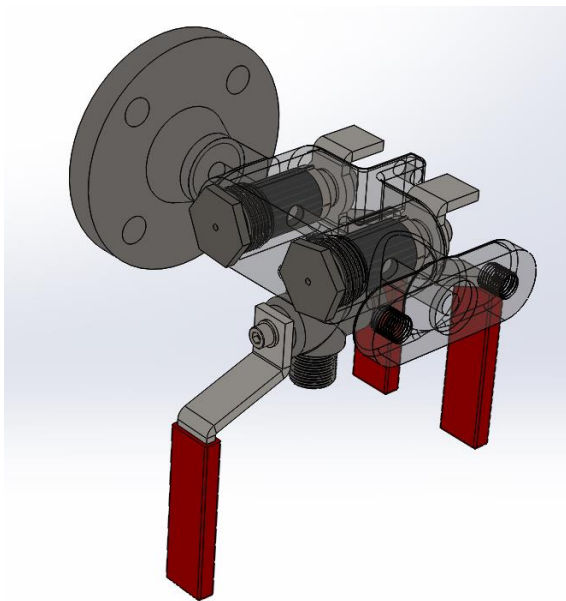


Figure 8. Full assembly viewed from gland follower side.

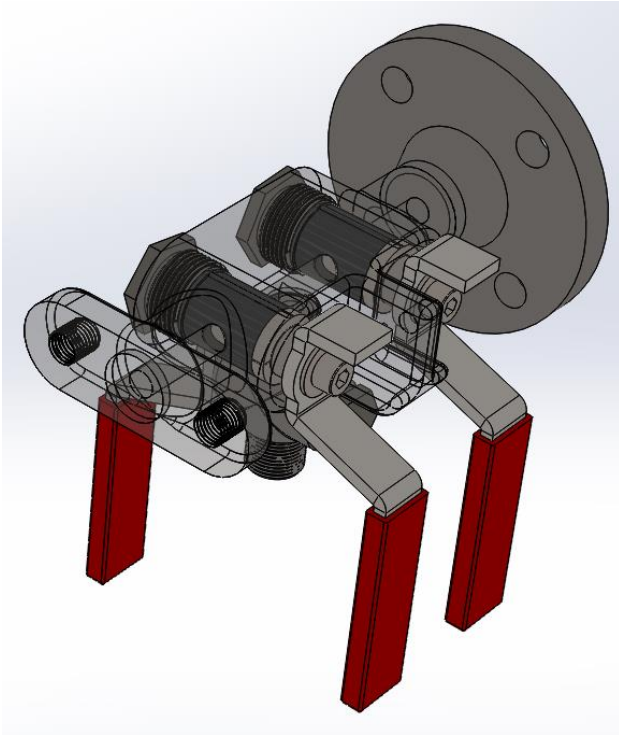


Figure 9. Full assembly viewed from isolation control side.

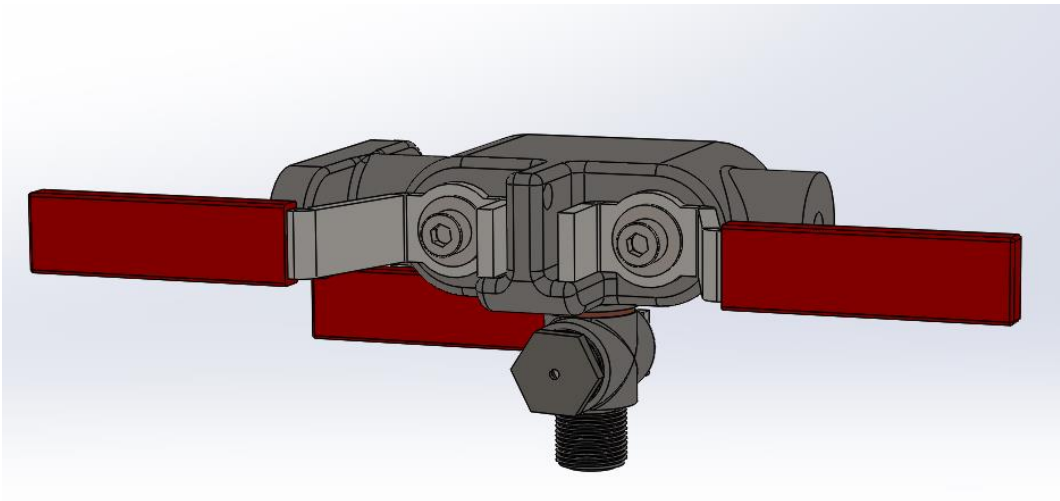


Figure 10. Full assembly valve in isolation position.

9.0 CAD Copy

The assignment is accompanied by the associated Solidworks files that detail the model components and associated drawings.

The design file is uploaded to Moodle along with the electronic copy of this assignment.

The content consists of 20 files, part models, part assembly and drawings associated with the double spindle isolation valve. Two further sub folders contain part models and assemblies detailing the original single spindle isolation valve and common drain valve, in total a further 11 files.

In summary

Drawing assembly 201 – Double isolation part view details an exploded view of the full assembly.

Part model 103 – Details double isolation body with weld neck connection.

Part model 103B – Details double isolation body with PN40 DN25 flange connection.

10.0 Conclusion

The Klinger D type isolation valve identified for redesign in line with the 'Serviceability' element of 'Design for 'x' – drivers for change' was selected on the basis of the problem of achieving suitable isolation under operating conditions. The background review of literature identified statutory requirements and guidance issued by the enforcing authority as the driver for change.

The design tools used in the problem, specifically root cause analysis and failure modes and effects analysis, successfully identified the root cause of the problem, and a delivered a viable solution which could be implemented through the redesign of the existing single spindle isolation valve.

The product design specification was driven by existing requirements of the original valve and incorporated the additional elements necessary to provide the double block and bleed isolation necessary to meet the user needs. A strong emphasis was placed on using standard components where possible and keeping within defined limits of dimension and weight. The use of a rating/weighting matrix identified the weakness is the first conceptual design proposal specifically around the use of standard parts and achieving isolation. The second conceptual design scoring higher in these areas, allowing the proposal to move to the CAD modelling stage.

The completed CAD model assembly has an indicate mass of 2.85kg inclusive of the PN40 DN25 mounting flange, compared to the existing isolation design at 1.9kg, this is within the limits of weight set by the product design specification. The overall length of the model at 194mm was also within the limits with respect to the original design at 133mm. The redesigned valve is proposed to be marketed as a double block and bleed arrangement with the designation of Klinger Type D-DB.

The overall design methodology applied in the redesign exercise was successful in identifying the underlying problem issue with the original design and specifying a suitable design solution. Which in turn is realised in a CAD assembly model and accompanying technical drawings.

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13.0 Appendices

13.1 Appendix 1 – Klinger D Type Isolation Valve



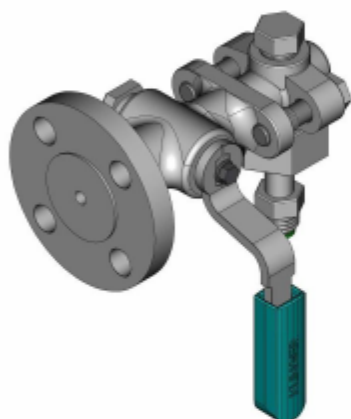
Rubinetto di Intercettazione D

Shut-Off Fittings Gauge Cock D

D

PN 64

ANSI 400



Klinger D: rubinetti di intercettazione per indicatori di livello, completi di bossoli Klinger a tenuta morbida. Collegamento agli indicatori di livello mod. R-D, R25, R50, R100, R160, T50, T100, T160.

Disponibile a richiesta esecuzione con doppia leva

Connessioni al serbatoio

Flange integrali:

UNI/DIN PN 25/40-DN 15, 20, 25
ANSI 150 RF- Ø ½", ¾", 1", 1 ½"
ANSI 300RF- Ø ½", ¾", 1"
ANSI 600 RF- Ø ½", ¾", 1"

Altre connessioni flangiate su richieste (saldate)

A richiesta: connessioni filettate maschio ANSI B2.1 Ø ½", ¾", 1" npt o bsp.

Connessioni al corpo della livella e al rubinetto

La connessione alla livella è formata da un tubetto liscio Ø 16mm che permette la rotazione del corpo della livella sul proprio asse.

I rubinetti possono essere forniti con sfere di sicurezza sia sul rubinetto superiore che inferiore.

Il rubinetto inferiore può essere fornito con un rubinetto di spurgo ABL 12

Codici Klinger per i materiali

FS/H Corpo acciaio al carbonio
interni in acciaio inox

M/H Parti bagnate in acciaio inox

M Completamente in acciaio inox

Klinger D: shut-off-gauge cocks sealed with Klinger soft packing sleeves.

Shut-off fitting for Klinger level gauges: R-D, R25, R50, R100, R160, T50, T100, T160.

On request construction with double lever.

Vessel connections

Integral flanges:

UNI/DIN PN 25/40-DN 15, 20, 25
ANSI 150 RF- Ø ½", ¾", 1", 1 ½"
ANSI 300RF- Ø ½", ¾", 1"
ANSI 600 RF- Ø ½", ¾", 1"

Other flanged connections on request (welded)

On request: male screwed connection ANSI B2.1 Ø ½", ¾", 1" npt or bsp.

Gauge body and gauge cock connections

Gauge connection is formed by end-tubes (16 mm o.d.) which are rotatably held within gauge cock stuffing box. Gauge cocks can be provided with safety balls in the upper and lower gauge cocks.

Lower gauge cock can be provided with an ABL 12 drain cock.

Klinger material-codes

FS/H Body: carbon steel
Trim: stainless steel

M/H Body and trim in stainless steel

M Completely stainless steel

Caratteristiche e dimensioni possono essere soggette a modifiche senza preavviso

Design and dimensions could be subject to modification without notice

Parti di ricambio

11	Guarnizioni	(2 pz)
2	Bossolo tipo AB 18	(2 pz)
18	Bademe KU 16	(2 pz)
	Bossolo tipo AB 12 per rubinetto ABL 12	(1 pz)

Altri materiali a richiesta

Spare parts

11	Gaskets	(2 pcs)
2	AB 18 packing sleeves	(2 pcs)
18	Packings KU 16	(2 pcs)
	AB 12 packing sleeve for ABL 12 cock	(1 pc)

Other materials on request

Rubinetto di Intercettazione D

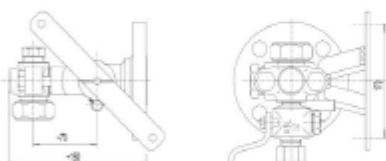
Shut-Off Fittings Gauge Cock D

D

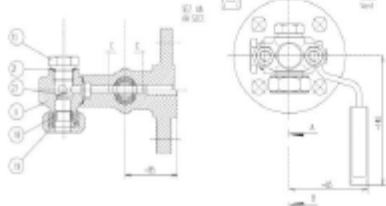
PN 64

ANSI 400

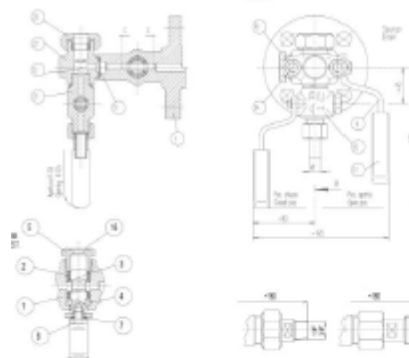
Esecuzione con doppia leva
Construction with double lever



Esecuzione con doppia leva
Construction with double lever



Rubinetto inferiore
Lower cock



	Componenti/parts	Materiali/materials*		
		FS/H	M/H	M
1.	Corpo livella/level gauge body	A 105	AISI 316 L	AISI 316 L
2.	Bossolo/packing sleeve	Graphite	Graphite	Graphite
3.	Maschio/plug	AISI 316	AISI 316	AISI 316
4.	Anello in due metà/split ring	AISI 316	AISI 316	AISI 316
5.	Tappo premibossolo/tightening nut	A 105	AUSU 303	AISI 303
6.	Maniglia/handle	Fe 37B	Fe 37 B	AISI 316**
7.	Rondella/washer	R40	R40	R40
8.	Vite/screw	8.8	8.8	AISI 304
9.	Flangia superiore D / D upper flange	A105 N	AISI 316 L	AISI 316 L
10.	Rubinetto ABL 12 / ABL 12 cock	A 105/316	316/316	316/316
11.	Guarnizione/gasket	Graphite	Graphite	Graphite
12.	Sfera di sicurezza (a richiesta) Safety ball	AISI 316	AISI 316	AISI 316
13.	Tappo di sfogo/stuffing box plug	A 105 N	AISI 316	AISI 316
14.	Tiranti/bolts	B7	B7	AISI 304
15.	Dadi/nuts	2H	2H	
16.	Targhetta/nameplate	AISI 304	AISI 304	AISI 304
17.	Impugnatura/plastic box plug	Nylon	Nylon	Nylon
18.	Baderna KU 16/KU 16 packing	Graphite	Graphite	AISI 304
19.	Anello premistoppa/packing gland	A 105	A 105	AISI 316
20.	Ghiera/nut	A 105	A 105	AISI 316
21.	Guarnizione su in/lower-upper gasket	Nickel	Nickel	Nickel
22.	Flangia inferiore D/D lower flange	A 105 N	AISI 316	AISI 316
23.	Molla superiore a richiesta/upper spring (on request)	AISI 301	AISI 301	AISI 301

* Vedi codici Klinger per i materiali

** A richiesta

* See Klinger material codes

** On request



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Pesi Approssimati/Approx weights Connessione flangia/Vessel Connection	Rubinetto superiore/ Upper cock	Rubinetto inferiore/ Lower cock
DN 20 PN 40/1" ANSI 150	3,0 Kg	3,6 Kg
DN 25 PN 40	3,3 Kg	3,9 Kg
3/4 ANSI 150	2,9 Kg	3,5 Kg
3/4 ANSI 300/600	3,3 Kg	3,9 Kg
1" ANSI 300/600	3,5 Kg	4,1 Kg
Filettato/Threaded 1/2" - 3/4"	2,6 Kg	3,2 Kg

13.2 Appendix 2 – Klinger Reflex Level Gauge R25

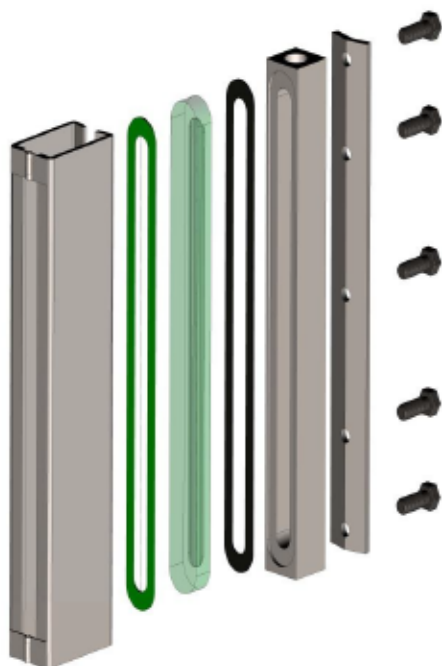


Indicatore di Livello a Riflessione

Reflex Level Gauge

R 25 -D
R 25-DG
R 25-RAV 956 / 946
R 25 RAV 957 / 947

PN 25 ANSI 150



Klinger R25: indicatore di livello a riflessione per vapore d'acqua e fluidi in genere predisposto per il collegamento al gruppo di intercettazione.

Con rubinetto a maschio a tenuta morbida modello ID (con Premistoppa) o modello DG (con nipples filettati).

Con valvole a tenuta metallica a vite esterna RAV 956 (con nipples filettati) o RAV 957 (con giunto a due pezzi). Disponibile anche a vite interna RAV 946/947.

Klinger R25: reflex level gauge for steam and process applications, Suitable for shut-off fittings:

Soft sealed gauges cocks, model ID (with packing) or model DG (with nipples).

Metal-to-metal sealed valves, RAV 956 (with nipples) or RAV 957 (rotatable), outside screwed types. Available also models RAV 946/947, inside screwed types.

Limiti di impiego

Working conditions

	P max	T max
Vapore/steam (D)	20 bar	215*
Petrochimica/process (DG-RAV)	PN 25/ ANSI 150	400°C

Codici Klinger per i materiali

Klinger material codes

FS/H: i componenti sono in acciaio al carbonio

FS/H: components in carbon steel

M/H: i componenti bagnati dal fluido sono in AISI 316

M/H: components in contact with media in AISI 316

(*) Altri materiali a richiesta

(*) Other materials on request

Accessori

Accessories

Rubinetto di drenaggio/sfiato

Drain/vent cocks

Riscaldamento o raffreddam. esterno

External heating or cooling

Lastra antibrina

Non-frosting block

Scala graduata

Graduated scale

Certificazione PED 2014/68/UE quando applicabile
Compliance PED 2014/68/UE when applicable

Attestazione ATEX 2014/34/UE su richiesta
Compliance ATEX 2014/34/UE upon request

Caratteristiche e dimensioni possono essere soggette a modifiche senza preavviso

Design and dimensions could be subject to modification without notice

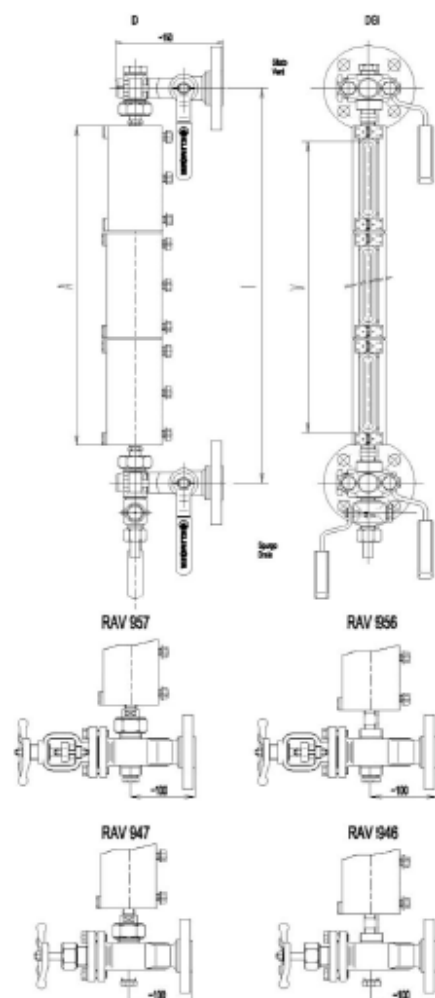


Indicatore di Livello a Riflessione

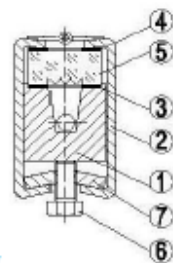
Reflex Level Gauge

R 25 -D
R 25-DG
R 25-RAV 956 / 946
R 25 RAV 957 / 947

PN 25 ANSI 150



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Tipo	Lungh. Corpo	Visibilità livello (V)	Peso appros.	Scartamenti minimo per indicatori di liv (mm) (I) Minimum center to center distance (mm) (I)			
				D	DG	RAV 956 RAV 946	RAV 957 RAV 947
Size	Body length	Sight length (v)	Approx weight	A+102	A+62	A+97	A+137
I	128	93	2,5	230	190	225	265
II	153	118	2,9	255	215	250	290
III	178	143	3	280	240	275	315
IV	203	168	3,7	305	265	300	340
V	233	198	4	335	295	330	370
VI	263	228	4,5	365	325	360	400
VII	293	258	5	395	355	390	430
VIII	333	298	5,7	435	395	430	470
IX	353	318	6	455	415	450	490
2 x IV	408	373	7,4	510	470	505	545
2 x V	468	433	8	570	530	565	605
2 x VI	528	493	9	630	590	625	665
2 x VII	588	553	10,2	690	650	685	725
2 x VIII	668	633	11,4	770	730	765	805
2 x IX	708	673	12,4	810	770	805	845
3 x VI	793	758	13,5	895	855	890	930
3 x VII	833	848	15,3	965	945	980	1020
3 x VIII	1003	968	17,1	1105	1065	1100	1140
3 x IX	1063	1028	18,6	1165	1125	1160	1200
4 x VII	1178	1143	20,4	1280	1240	1275	1315
4 x VIII	1338	1303	22,8	1440	1400	1435	1475
4 x IX	1418	1383	24,8	1520	1480	1515	1555
5 x VII	1473	1438	25,5	1575	1535	1570	1610
5 x VIII	1673	1638	28,5	1775	1735	1770	1810
5 x IX	1773	1738	31	1875	1835	1870	1910
6 x VIII	2008	1973	34,2	2110	2070	2105	2145
6 x IX	2128	2093	37,2	2230	2190	2225	2265
7 x VIII	2343	2308	39,9	2445	2405	2440	2480
7 x IX	2483	2448	43,4	2585	2545	2580	2620

	Componenti - I Parts	Materiali - Materials*	
		FS/H	M/H
1	Corpo livella/level gauge body	ASTM A 105	AISI 316
2	Frontale/cover	Fe 430	Fe 430
3	Guarnizione di tenuta/sealing gasket	GRAPHITE PSM	GRAPHITE PSM
4	Guarnizione di appoggio/cushion joint	KLINGERSIL	KLINGERSIL
5	Cristallo/glass A	BOROSILICATE	BOROSILICATE
6	Viti di serraggio/bolts	8.8	8.8
7	Plastra/Plate	Fe 430	Fe 430

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