DG Nuclear

Uniflex-stow remote valve operating systems

Rigid rod system

1. GENERAL

Rigid rod gearing for the operation of valves is to be fitted where:

a. The standard lever or handwheel cannot be fitted or operated due to the restricted space or the position in which the valve has to be sited.
b. A requirement for operation from more than one position is specified in the building specification.
c. The valve is located in a physically difficult to access position or hazardous/restricted environment
d. Where local operation raise a safety issue
e. When manual mechanical systems are required for reasons of back-up (redundancy and diversity)

Selection of a suitable Uniflex-stow solution

The Uniflex-stow range features three systems;

Uniflex-stow flexible shaft system with integrated gearing
Uniflex-stow flexible shaft
Uniflex-stow rigid rod

In general Uniflex-stow flexible shaft systems should be selected for longer and/or more complex routings. If, when considering a rigid rod installation, the routing is longer than 20 ft and/or, regardless of length, has more than two 90 degree gearboxes then select a flexible shaft system.

2. INSTALLATION DESIGN

The rod gearing installation is to be constructed using the standard components listed in the current Uniflex-stow catalog.

All rod gearing is to be run as directly as possible. If the routing demands more than two 90 degree intermediate gearboxes and/or exceeds 20 ft in length then a flexible shaft system should be used. This is because the additional complexity of the installation creates additional cost due to significant installation time and ongoing maintenance issues caused by misalignment due to increased risk of poor installation and normal 'wear & tear' issues.

All rotating parts of the valve operating gear are to have sufficient clearance to ensure free movement. Where rod gearing passes through areas where may come into contact with people it is recommended it is fitted with dustproof guards of aluminum alloy sheet of sufficient strength to prevent the possibility of contact between guard and moving parts. Access flaps are to be provided to allow ready access to the gearing.

Where rod gearing, of necessity, passes through a bulkhead/wall or deck/floor, a suitable penetration unit should be used.

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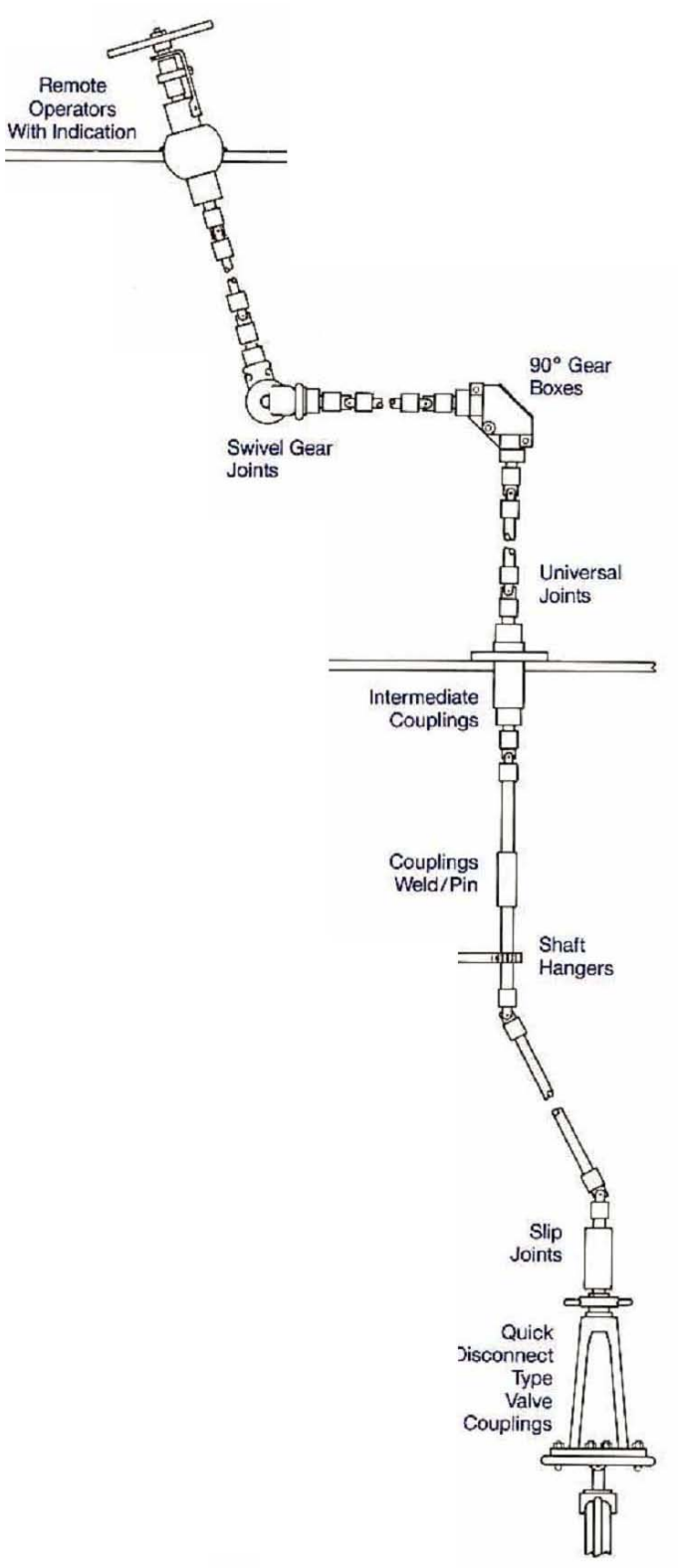

The terminal point of rod gearing is to be fitted with a handwheel or lever as required. The terminal points are to be provided with indicators to show the position of the valve, and suitable locking arrangements are to be provided where applicable.

Rod gearing is to be supported by angle boxes, support bearings or hanger brackets. The shafting connecting these fittings is to have universal joints fitted at each end. The forks of universal joints mounted on the same shaft are to be parallel to one another. Where shafting is arranged in a horizontal position, without covers, it is to be of sufficient strength to support 100 kg (220 lbs) at its mid point in addition to its full torque.

For shafting between universal joints, the distance between adjacent universal joint knuckles is defined as the “free length”. This free length must not be supported in any way other than by the universal joints. The free length should not exceed the following:

Bar size	Max.unsupported length
½”	3 ft
¾”	5 ft
1”	8 ft
1 ¼”	10 ft

Seismic considerations:
When installed for safety related, category I, equipment use the following:

Bar size	Max.unsupported length
½”	4’ 6”
¾”	5’ 6”
1”	6’ 6”
1 ¼”	7’ 6”

This is based on a natural frequency of 20 cps for a piping system and is derived from beam formulas with both ends simply supported. The resonant frequency is limited to 14 to 17 cps.

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Provision for Expansion

An expansion coupling is to be fitted in each length of shaft between universal joints. Where the supports are, of necessity, close together, a double universal joint may be used. This joint is connected at one end using keys and allows an expansion movement of 1/2”. When one or both supports of the shafting is on a bulkhead, an expansion coupling with a plus or minus 50 mm (2 in) movement is to be fitted in the free length adjacent to the bearing support. When rod gearing is fitted between deck and deck head well clear of bulkheads or the ship’s side, the expansion movement is to be at least plus or minus 100 mm (4 in). For expansion joints it is essential to set the length of shafting so that the travel after assembly allows for an equal increase or decrease in the distance covered by the free length.

Provision for thrust

Thrust washers or bearings are to be provided on vertical shafts where a support bracket is used, to cater for the weight of the normal free length of shafting, universal joints, etc.

Alignment

Support brackets are to have their shafts aligned. Displacement of the shaft centers is not to exceed an amount causing the universal joints to operate at an angle greater than 20 degrees . This permits displacement due to damage without preventing the system from operating. Axial displacement of adjacent support bearings, where necessary to avoid obstructions, should ideally be such that all the journal bearings are parallel to one another.

Angle boxes

90 degree gear boxes are to be secured to a rigid structure.
Geared boxes: When the permissible torque exceeds that which can be applied by hand for the particular shafting or fittings used, or where a better degree of control is required, a reduction gear box may be fitted. This gearbox is to be fitted on or close to the valve.

Penetrating a Shield Wall or Floor

There are several types of shield wall and floor penetrations that are installed by utilizing either the cast-in-place or grout-in-place construction methods.

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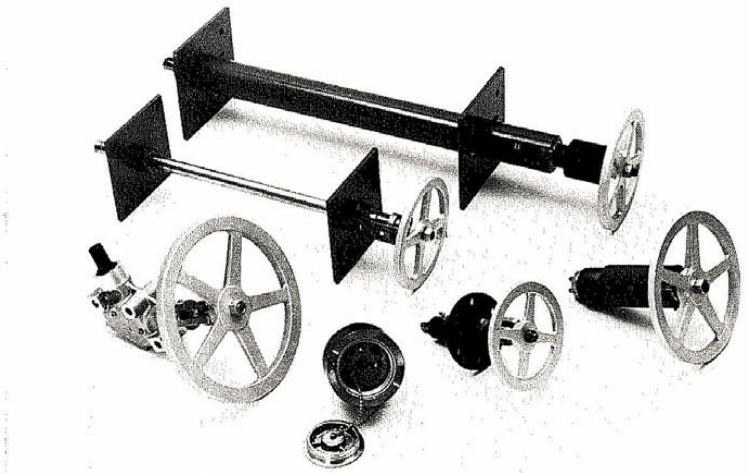

Penetrations/Operating Stations
1 — Shielded Penetration Wall or Floor Housing Assembly with Indicator, Clutch

Cast-In-Place: This method is recommended when schedules permit advance planning of the penetration location. The cast-in-place type housing is attached to the concrete forms and becomes a permanent part of the wall at the time the concrete is poured.

Grout-In-Place: This method is generally specified when the exact number and location of penetrations is not known prior to the pouring of the shielding wall. Usually, several possible locations are selected and six (6) inch diameter, schedule 40 pipe is embedded when the wall (or floor) is poured. Later, the grout-in-place type housing can be inserted into one of the pipes and set in place with high- density grout. An alternate method is to core-drill a hole through the shield wall, insert the grout-in-place type housing and set in place with high-density grout.

Both types of shield wall and floor housings are designed with a compensating spindle length that will accommodate plus or minus one-half (1/2) inch from nominal wall thickness.

The shielded penetration is 100% serviceable from the “cold side” of the shield wall, including seal replacement. Spindle bearings on the “hot side” of the wall are oil- impregnated sintered bronze and highly resistant to the effects of radiation.

Operating Stations for Shielded Penetrations

The addition of a Stow Torque-Limiting Clutch to an operating station (plain or indicating) permits the controlled operation of small plug, ball, diaphragm or instrumentation valves without the attendant concern for over-torquing valve stems or seats.

Stow’s torque limiting clutch can be easily set to any torque within its range of 0-1000 inch-pounds after installation into a system.

The clutch is permanently lubricated and has a repetitive accuracy of approximately 95° over its full operating range.

Operating Stations for Nonshielded Penetrations

Handwheels mounted on torque transmission spindles, wall terminals and floor stands make up the basic operating stations. A 90° gearbox (with indicator) operating station is available to bring high or low wall penetrations to a comfortable chest-high operating height.

Deck Box(Sockets)

Deck sockets may be used in certain positions, ie in narrow gangways where a handwheel or lever would obstruct free passage. The top of the socket is to be flush with the deck (inclusive of deck coverings). The key for the socket is to be supplied and fixed in a suitable adjacent stowage. The service to which the deck socket is connected is to be marked on the top face of the socket and not on the cover.

Indicating plates

Indicating plates of suitable material marked “open” and “shut”, are to be fitted at each valve, and at each operating position. Indicating plates are to be permanently secured so that they cannot be removed for cleaning, or interchanged, and are to be clearly marked with the position and function of the valve.

3. CONSTRAINTS and CHARACTERISTICS

The proper function of the rotary flexible shafting mechanical actuator system is limited by the following constraints:

(1) Maximum System Length :	50 feet (reasonably straight run)
(2) Maximum number of components:	no more than 2 intermediate gearboxes.
(2) Operating Environment :	-65° to + 800°F and 0 to 100% Relative Humidity.
(3) Minimum Length :	Approx. 1 Ft
(4) Shock :	System meets requirements of MIL-S—901D Grade A Class I.
(5) Maximum Capacity at Valve :	210 ft.-lbs
(6) Operator Directional Rotation vs Valve Directional Rotation :	Same Direction.
(7) Vibration :	System Meets Requirements of MIL-STD-167 (8) Leakage (Immersion) : Components maintain watertight integrity per MIL-810-E
(9) Leakage (Pressure):	Components maintain watertight integrity per MIL-S-16059 tested at depth of 65ft
(10) Corrosion :	All exposed components are non corrosive materials. No components including internal items shall exhibit noticeable corrosion after being exposed to 10,000 hours salt fog test per MIL—STD-810-E Section 590.3.

(11) Maintenance : Shall not require scheduled maintenance beyond that outlined here

4.MATERIALS

Rod Shafting
Shafting is to be selected from either solid drawn steel tubing or solid steel rod.

Support brackets, gearbox housings, UJ's and other components
Where support brackets and gearbox housings are fitted in corrosive environment they are to be of the suitable materials. Elsewhere they may be of the ferrous materials.

Handwheels
Handwheels and levers are to be in forged steel, aluminum alloy, or bronze. Where handwheels or levers are fitted in exposed positions on the upper deck, or in humid compartments, they are to be galvanized.

Low permeability properties
Where low magnetic permeability is a requirement, and in certain specifically approved cases, all components are to be made from low permeability materials.

5. SELECTION OF COMPONENTS

Identification of components

The standard range of components are listed in the latest product catalog.

Valve operating torques

Before designing the rod gearing installation, the appropriate torque value of the valve at the operating pressure must be obtained from the valve drawing or manufacturer. Valves 150 mm and above are normally fitted with geared operators which reduce the torque at the operator shaft in proportion to the mechanical advantage

The torque limits for control rod shafting and fittings are:

½"	20 ft lbs
¾"	52 ft lbs
1"	122 ft lbs
1 ¼"	210 ft lbs

Method of determining size of fittings to be used

A remote valve operator system can be designed using rigid rod components where operating speed is slow or intermittent and rotates in either direction.
The table I in appendix can be used to apply design factors to determine the specifications of suitable rigid rod components in a remote valve operator system.
Use the following steps to determine the correct rigid rod diameter and remote operator handwheel diameter.

1. Select the design factor (A, B, C or D) that most closely approximates the system under consideration.

2. Determine the valve handwheel diameter or valve operating torque for the valve that is to be remotely operated.

3. Reading down the appropriate design factor column and over from the valve handwheel/operating torque determined in two (2) above, locate the point of intersection under the column headed "rod dia." and "h. wheel dia."

Note: The handwheel diameter at the remote operator has been increased to compensate for transmission system losses.If the rotation at the operating position is less than one turn, then a lever may be fitted. If the rotation is more than one turn, then a handwheel will be fitted.

6. COMPONENT ASSEMBLY

The elements of a rod gearing installation are to be connected together with socket joints secured with tension pins. All sockets to take shafting are provided with pilot holes for the tension pins. The holes for the pins are to be drilled to the nominal pin size. The pins are made oversize to ensure they are tight when driven in.
The surface of shafting in the way of fittings is to be polished with fine emery cloth to obviate the propagation of surface cracks in the vicinity of the tension pin holes.
All hollow shafting that does not terminate in a secure blank fitting (such as the pinned sleeve of a universal joint) shall be securely plugged. In this regard, the use of plastic such as PTFE will be permitted. The tension pins are to be fitted so that the slot is in line with the axis of the shaft. They are to be positioned so that their ends are below the surface of the boss, and the metal of the boss peened over to prevent the pins from working out.
Care is to be taken when mounting universal joints on a shaft that the adjacent knuckle pins are parallel.

When expansion couplings are fitted, care is to be taken that, upon final assembly, the expansion joint is in its mid position.
External surfaces of ferrous shafting and components are to be painted as required. Care is to be taken that the paint does not foul moving parts or bearing surfaces.

Once the system is completely installed, it may be desirable for future reference to determine and record the frictional load of the system. This is the torque required to operate the system with the valve fully disconnected.

This is an example of a typical installation procedure;

1. Mount remote operator and, if required, any through wall/floor penetration unit. Set indicator to closed position.
2. Attach the intermediate components to rigid structure; ie 90 degree gearbox and check to ensure approximate alignment with other system components
3. Attach valve coupling to valve handwheel or valve input spindle.
4. Position valve and indicator mechanism in desired position ie; cycle valve closed, and then position indicator to read closed position
5. Attach UJ's to components
6. Measure distance between UJ positions and cut solid rod/tube to suit.

7. Fit any support brackets over rod/tube prior to assembly to UJ. Brackets should be mounted on rigid structures.
8. Fit rods to UJ's . Secure any brackets.
9. Operate to check for misalignment and if necessary make adjustments to installation.
10. Cycle system to fully open position and record open position. Cycle system to fully closed position and record closed position. 11. Once system is fully installed and operational, open and close system with a torque wrench and record operational torque. Mark this number on system tag for future reference.

APPENDIX

Rigid Rod Selection Guide Table I

			A		B		C		D	
Typical System Requirement Examples	**Valve Hand-wheel dia. (in.)**	**Valve Operating Torque (ft. lb.)**	**rod dia (in)**	**h/w dia (in)**	**rod dia (in)**	**h/w dia (in)**	**rod dia (in)**	**h/w dia (in)**	**rod dia (in)**	**h/w dia (in)**
A. Remote Operating Station (1) Universal Joints (2)	3	10	1/2	4	1/2	4	1/2	5	1/2	6
B. Remote Operating Station (1) Universal Joints (4) 90 degree Gear Box (1)	4	13	1/2	4	1/2	5	1/2	6	1/2	7
C. Remote Operating Station (1) Universal Joints (6) 90 degree Gear Boxes (2)	5	17	1/2	6	1/2	6	1/2	7	1/2	9
D. Remote Operating Station (1) Universal Joints (10) 90 degree Gear Boxes (3) Intermediate Connection (1)	6	20	1/2	6	1/2	7	1/2	9	3/4	11
	7	26	1/2	8	1/2	9	3/4	11	3/4	12
	8	30	1/2	9	3/4	10	3/4	11	3/4	12
	9	34	3/4	10	3/4	11	3/4	12	3/4	14
	10	40	3/4	11	3/4	12	3/4	14	3/4	14
	11	46	3/4	12	3/4	12	3/4	14	3/4	16
	12	52	3/4	14	3/4	14	3/4	16	1	18
	14	70	1	16	1	18	1	21	1	21
	16	80	1	18	1	18	1	21	1	24
	18	90	1	21	1	21	1	24	1	24
	21	122	1	24	1	24	1	27	1 1/4	27
	24	140	1 1/4	24	1 1/4	27	1 1/4	27	1 1/4	30
	27	158	1 1/4	27	1 1/4	30	1 1/4	30	1 1/4	36
	30	175	1 1/4	30	1 1/4	30	1 1/4	36	1 1/4	36
	36	210	1 1/4	36						